

A REALIST'S GUIDE TO GERRYMANDERING

a tale of

math, computing, statistics, law, political science, geography

Moon Duchin
MGGG Redistricting Lab

@IU Social Science Research Commons
Workshop in Methods, 11/8/2019

SALEM GAZETTE.

VOLUME XXVII.]

SALEM, FRIDAY, APRIL 2, 1813.

[No. 27.]

THE GERRY-MANDER,

OR

ESSEX SOUTH DISTRICT FORMED INTO A MONSTER!



FEDERALISTS! FOLLOWERS OF WASHINGTON!

AGAIN behold and shudder at the exhibition of this terrific Dragon, brought forth to swallow and devour your Liberties and equal Rights. Unholy party spirit and inordinate love of power are its birth, your patriotism and honest

requisition their utmost cunning to devise means expressly to accommodate their own views and to promote their own interest, should still be unwilling to adhere to the policy prescribed by themselves.

Such a man would have to learn, that violence and subordination must be employed to accomplish what dishonesty and trick had failed to secure. It is in fact the settled maxim of some, who, if the testimony of their own professions is to be credited, have much love for the people and a sacred regard for their rights, to condemn all legal provisions, which impede their ambitious designs, however just and necessary to secure the peace and order of society; to execute by force whatever they are prohibited to do by law, and to aggrandize themselves without respect to justice or decency. Upon no other principle can we account for the conduct and activity of those, who, at a late election in this town, scrupled not to bring to the poll, not only alien residents, who were known never to have been naturalized, not only a certain clergyman (the learned Commentator of Politics for this vicinity) whom they had, in common with the rest of his brethren, disqualified to vote in the choice of town officers, and thus to involve him in the turpitude of their transgressions, and to multiply the causes of repentance, (unless he so far believes, "that the end would sanctify the means," that there would be *non causa penitentiae*); but even to seduce citizens from other towns, to invest the minority with a power, which they would be sure to abuse. He, who promises freedom to the captive, when he increases the number and weight of his chains, acts as consistently, as he does, who declaims much and loud about the liberties of the people and the rights of his country, when all his actions evince, that he regards neither the one nor the other, any farther, than he discovers a direct advancement of his own interest. It is greatly to be desired, that honest men would sometimes suffer themselves to be influenced as well by objects of vision, as hearing, and compare actions with professions; and then let judgment decide upon the worth of character, and the safety of reposing confidence.

CIVIS.

Mr. PRINTER,—I am a native of Great-Britain, and some years ago was naturalized at Gottenburg; but for several months I have been engaged in trade in this State. I have seen very pressing notices of the Marshal for alien enemies to report themselves forthwith. While I remain here I wish to comply with the laws and ordinances of the country, and

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When Tyranny and arbitrary Power thus make inroads upon the Rights of the People, what becomes the duty of the citizen? Shall he submit quietly and ignominiously to the decrees of Usurpers? Are the citizens of this Republic less jealous of their rights than their ancestors? Will you, then, permit a Party to disfranchise the People,—to convert the Senate Chamber into a Fortress in which ambitious office-seekers may entrench themselves and set at defiance the frowns of the People? No,—this usurping Faction must be dislodged from its strong-hold.

Arise, then, *injured Citizens!* Turn out! turn out! let Monday Next be the day of your Emancipation—by one manful Struggle reclaim your usurped Rights—and frown into obscurity those audacious men who unblushingly boasted—“*We have secured the Senate for ten years, and should have been Fools if we had not done it.*” Prove on election day that the Folly of their men is equal to their want of honesty and contempt of the People. Elect patriots who will be loyal to the Constitution, and faithful to the interests of the State,—men who will harmonize with our illustrious STRONG,—and who will not sell our Drafted Soldiery, like Hessians, to any Foreign Power.

Salem,

FRIDAY, APRIL 2, 1813.

SOUTH with a Vengeance!

The Senatorial District made and called “ESSEX SOUTH District,” by a Gerry-mander Legislature, has the following peculiarities:

1. It contains three Towns (Salisbury, Amesbury and Haverhill) more *northerly* than any other town in the County.
 2. An East and West line drawn through the centre of the County leaves Salisbury, Amesbury, Haverhill, Methuen, a large part of Andover and a small part of Middleton [six] on the *Northern* side.
 3. The only towns wholly in the *southern* section of the county that the district contains, are Danvers, Lynnfield, Salem, Marblehead and Lynn [five].
 4. The *northernmost* town of another county is tacked on it.
- ☞ There neighbor, take a piece of chalk and see if it does not come out so.

Measures for Defence have been adopted in all the ports threatened by the British Squadron. At Wilmington a Committee of Safety has been appointed. The Honorable Messrs. BAYARD and HORSEY, (U. S. Senators from Delaware) and other zealous Federalists constitute this Committee. These are the Patriots on whom the country must rely when the hour of extreme peril approaches. Our democratic rulers have sufficient talents to plunge the nation in misery and calamity, but none but Federalists can rescue the nation and save its “drowning Honor.” The deceased Heroes WASHINGTON, LINCOLN, KNOX, WAYNE, MORGAN and HAMILTON,—the Soldiers of Liberty who achieved our Independence,—were zealous and decided *Federalists* to the last hour of their lives;—and even WASHINGTON was calumniated and traduced as a British Tory by the Democratic party,—which party he solemnly declared in a letter to a friend was “A CURSE TO THIS COUNTRY.” This same party is now scourging the country with War, and the People *feel* the truth of the words of WASHINGTON.

The Right of Suffrage.

ALL men will agree in the importance of having the right of suffrage properly defined by law; and most men, when uninfluenced by passion, will acknowledge the necessity of enforcing the law with the utmost strictness, and can correctly calculate the immense benefits which would result from such a course. —These are the natural dictates of the understanding and of conscience. But man in *theory* and in *action* is not the same being. In the dispassionate moments of speculation, he listens to the suggestions of his reason, and approves of the admonitions of his understanding; but in practice he acknowledges no law but convenience, and feels no satisfaction for his exertions except in triumph and victory.—To a person, whose astonishment had not been so often excited, till he had become incapable of new surprise, by the moral phenomena which are continually occurring in the political world in these days of strange delusion and of disasters; it would appear incredible, that a party of men, after they had had the opportunity of putting in

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“UNDER A SIGNATURE.”

Is the correct, and was once the universally received phrase. But a spirit of innovation and hyper-criticism directed by gross misconception has engendered and brought into too general use the awkward and absurd term, “*over a signature.*”—To show how mischievous tolerated abuses are, we would refer to the following from the Boston Gazette. “*The Road to Peace.*”

“Messrs. Russell & Cutler—I have read a very sensible, but small tract [compose your muscles, gentle reader] *over the above title.*” &c.

Now, the tract, “*over*” this title is worthy of all praise for its correctness and candor, and may be read *without offence* and certainly with advantage, *by all parties.* It is peculiarly calculated for *distribution*—it *repels no reader*, whatever be his politics or character.

Given *over* my hand and seal, March, 1813.

THE GOOD OLD WAY.

DARKNESS VISIBLE.

Mons. GALLATINI has directed the Lights near the Chesapeake and Nantucket to be extinguished, so that our Enemies may be left in the dark; and of course it will be perfectly easy to place Torpedoes under the Fleet and blow it out of our waters.—How perfectly in character is it for our present rulers to *extinguish* instead of illuminating, and to scatter *darkness* where their predecessors diffused *light.* It is the sport of these Proclamation-men, like Mad Tom,

“To play at bowls with sun and moon,
“And shade them in eclipses.”

It is expected that every man who does not wish to be drafted as a conscript and sent out of the State to fight the battles of the Southern Nabobs—every Farmer who wishes to prevent his farm and stock from being seized and sold to pay the enormous taxes which are shortly to be laid on them, will turn out on the first Monday of April next, and support the Peace Ticket.—New Hampshire has set a bright example; let us follow it. You all know you were prosperous and happy under Washington; you are now wretched and miserable under Madison.—You cannot, you will not give your suffrages for men who are in favor of the present war, unless you are unjust to yourselves, and unfaithful to your country.—*Augusta Herald.*

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The Right

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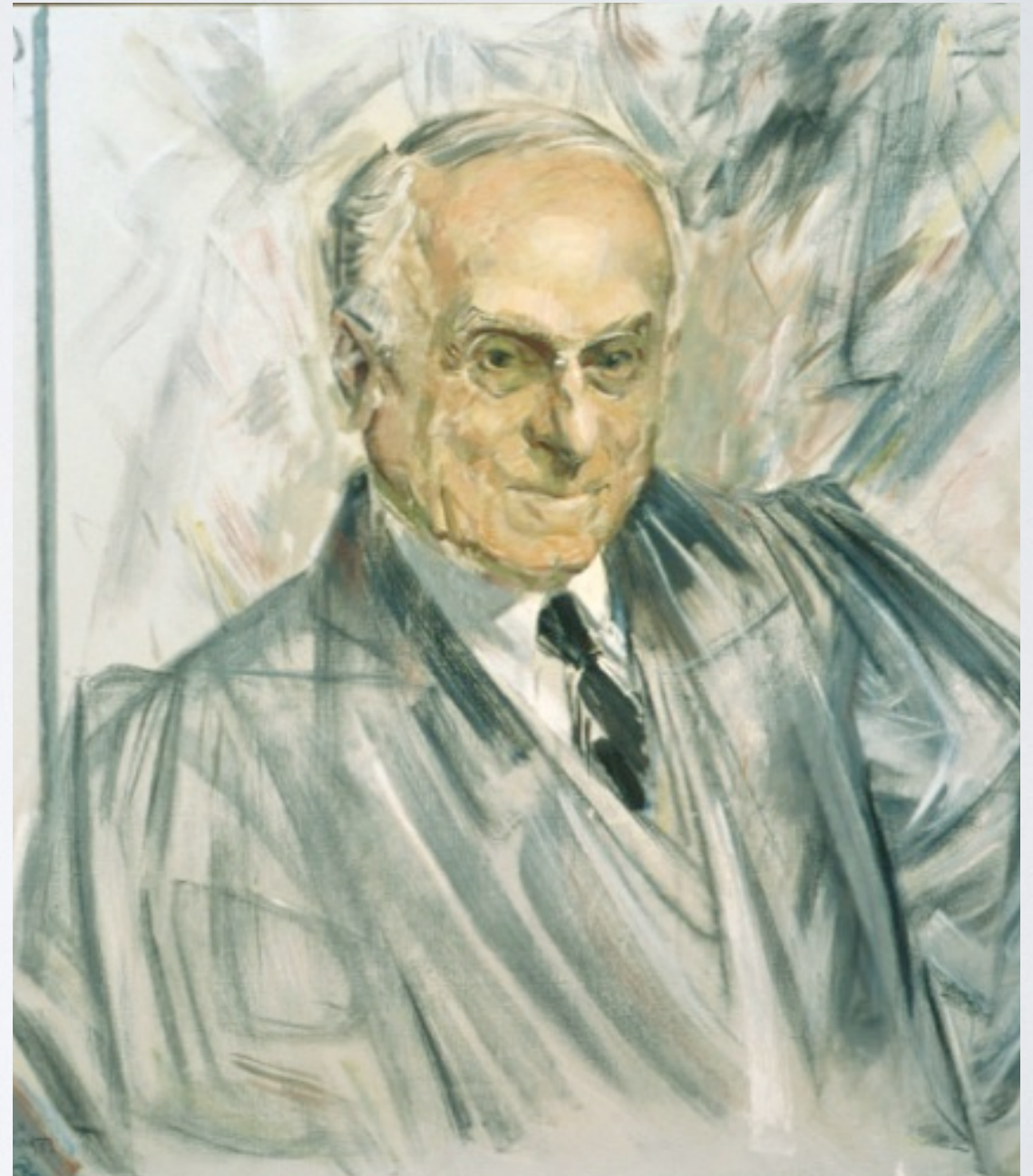


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FELIX FRANKFURTER

Colegrove v Green, 1946

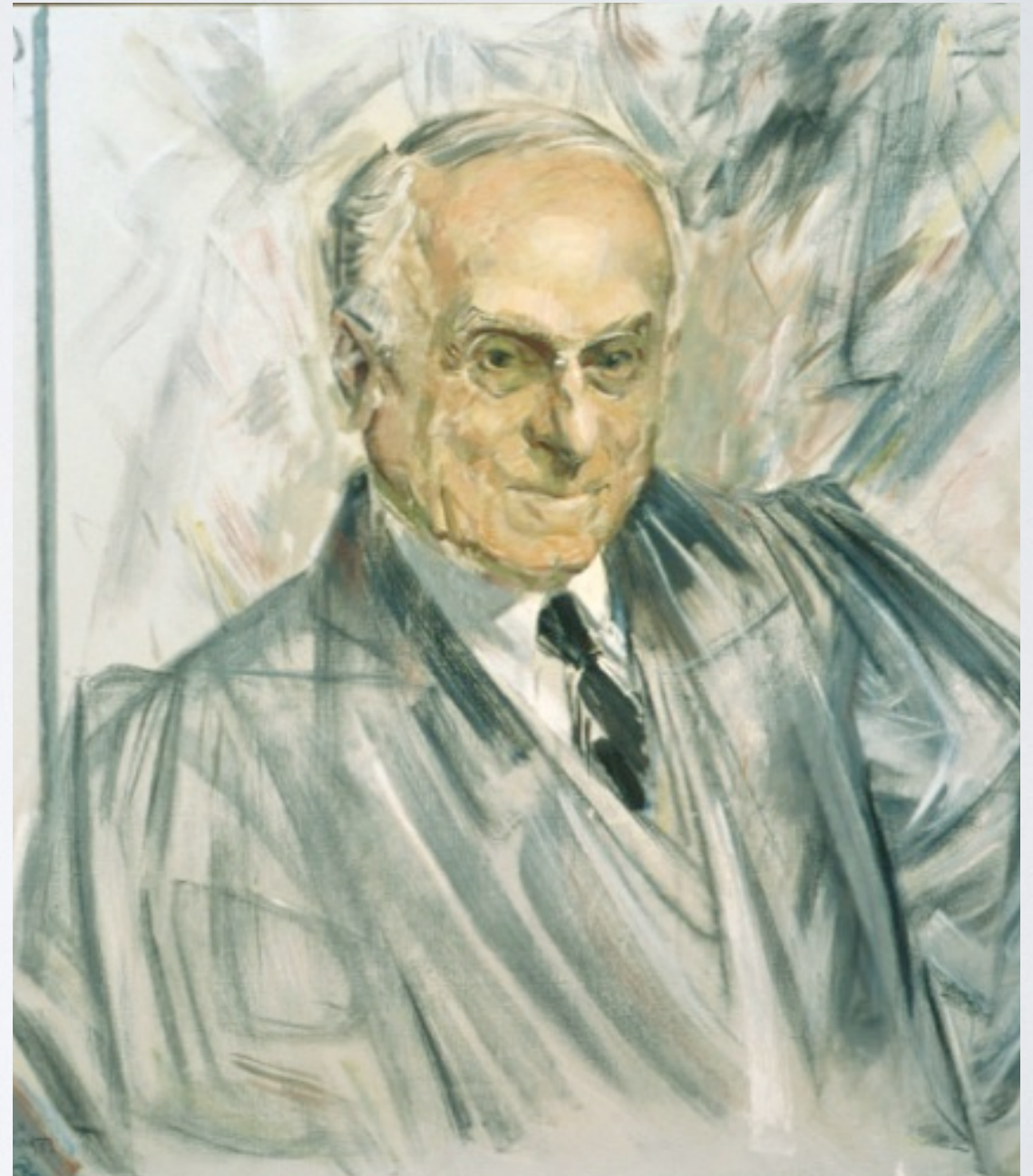
- “Throughout our history... the most glaring disparities have prevailed as to the contours and the population of districts.”
- “Courts ought not to enter this **political thicket**.”



FELIX FRANKFURTER

Baker v Carr, 1962

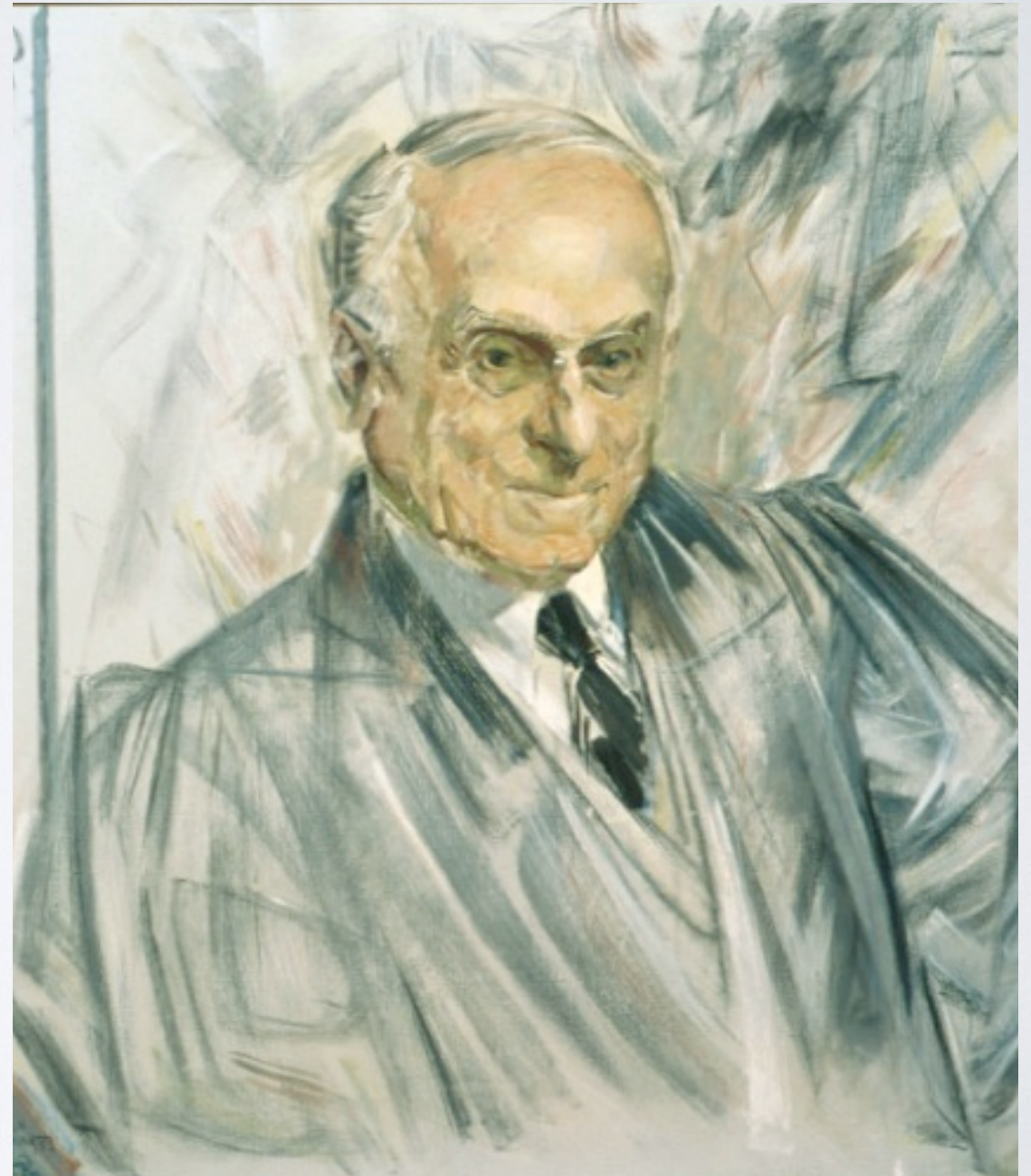
- “One of the Court's supporting opinions, as elucidated by commentary, unwittingly affords a disheartening preview of the **mathematical quagmire** (apart from divers judicially inappropriate and elusive determinants) into which this Court today catapults the lower courts of the country without so much as adumbrating the basis for a legal calculus as a means of extrication.”



FELIX FRANKFURTER

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- “This [intervention], of course, implies that **geography, economics, urban-rural conflict**, and all the other non-legal factors which have throughout our history entered into political districting are to some extent not to be ruled out in the undefined vista now opened up by review in the federal courts of state reapportionments.”



8-1 MAJORITY

Reynolds v Sims, 1964

- “We are told that the matter of apportioning representation in a state legislature is a complex and many-faceted one. We are advised that States can rationally consider factors other than population in apportioning legislative representation. We are admonished not to restrict the power of the States to impose differing views as to political philosophy on their citizens. We are cautioned about the dangers of entering into political thickets and mathematical quagmires. Our answer is this: **a denial of constitutionally protected rights demands judicial protection; our oath and our office require no less of us.**”



5-4 MAJORITY

Rucho v Common Cause, 2019

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A stylized, black, hand-drawn Japanese character 'ツ' (tsu) is centered within a white rectangular box. The character is composed of several thick, black strokes. The box is framed by a thin black border. The background of the slide is a light gray.

Key question

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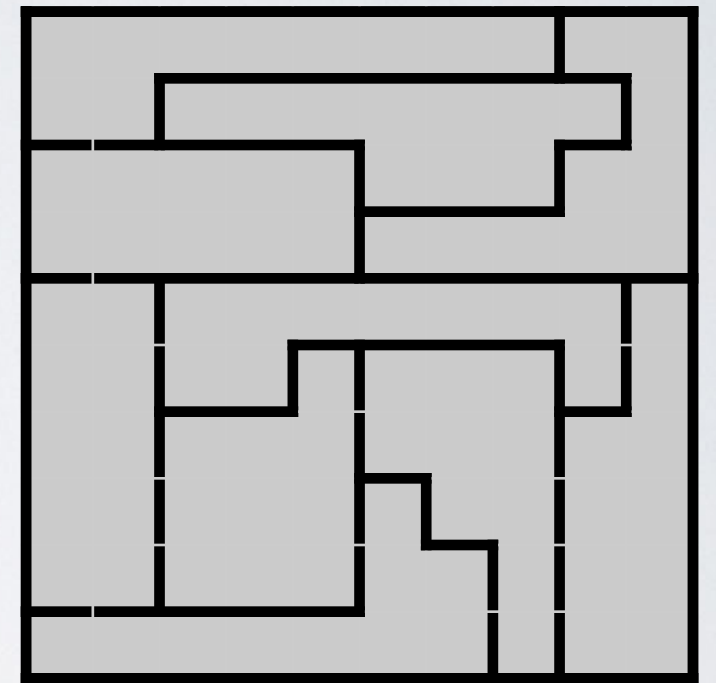
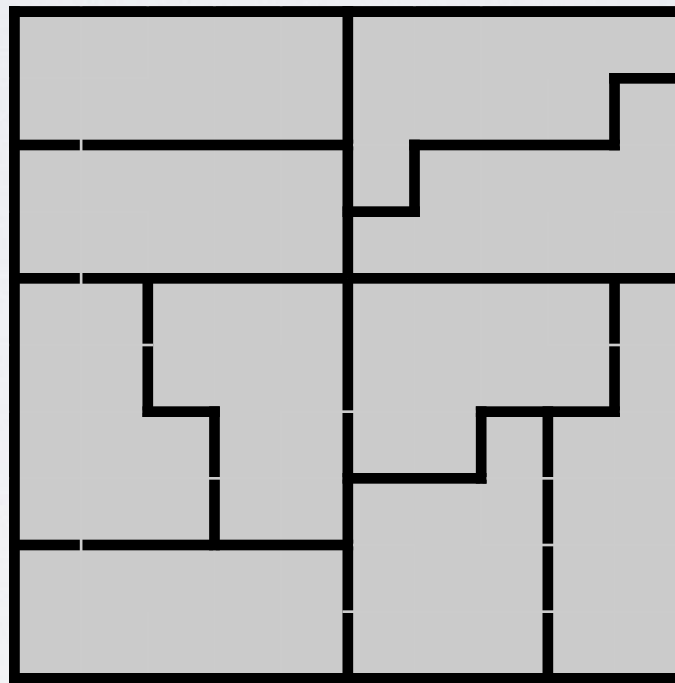
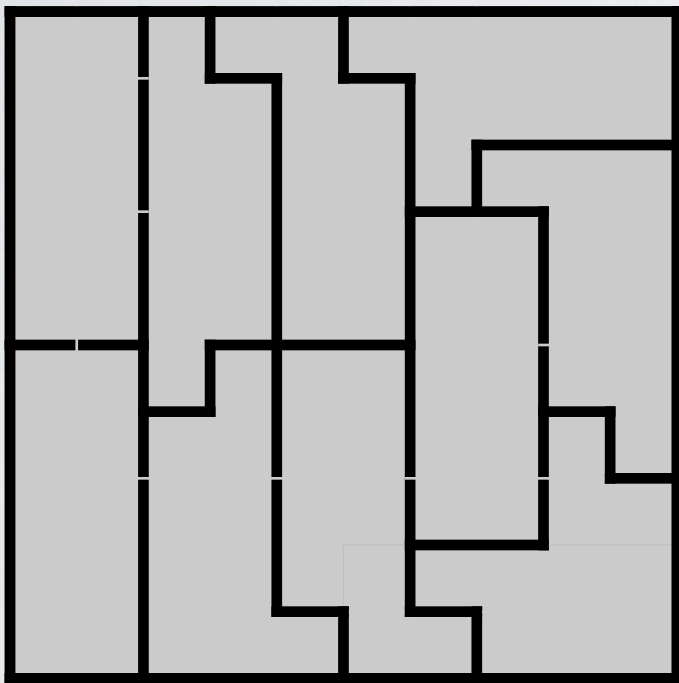
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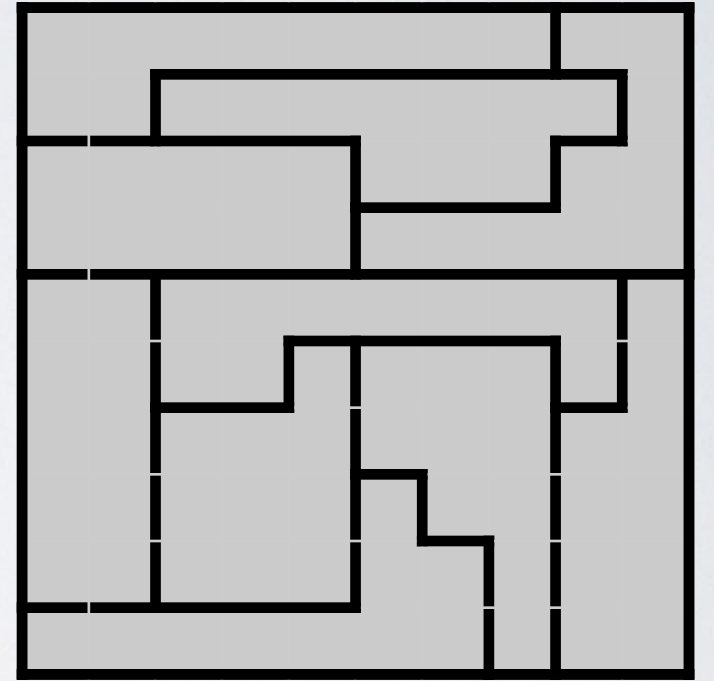
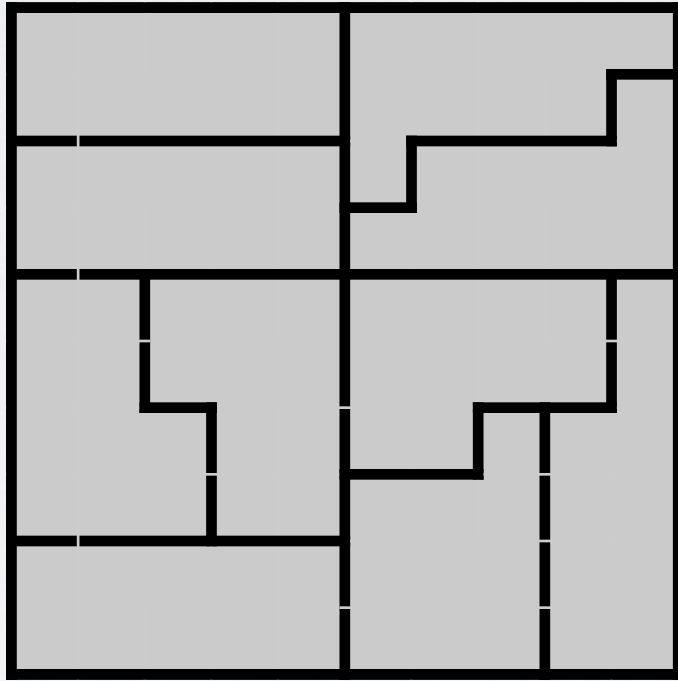
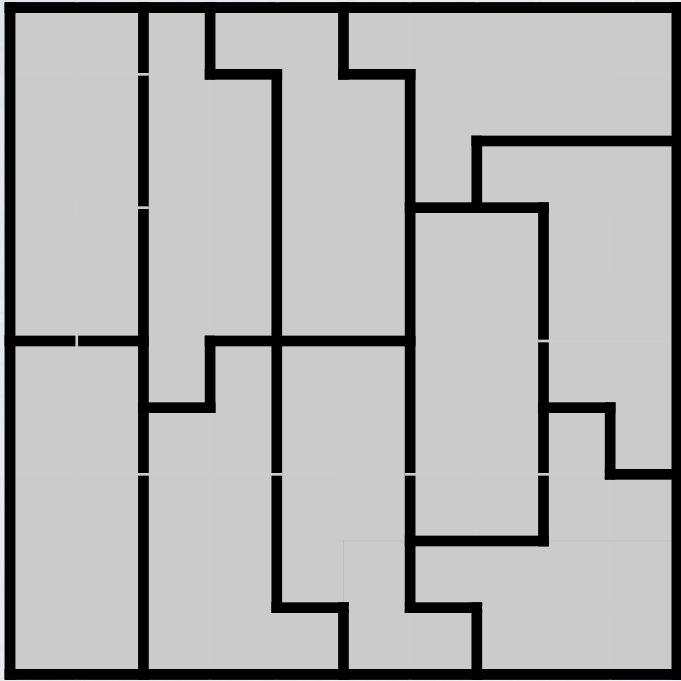
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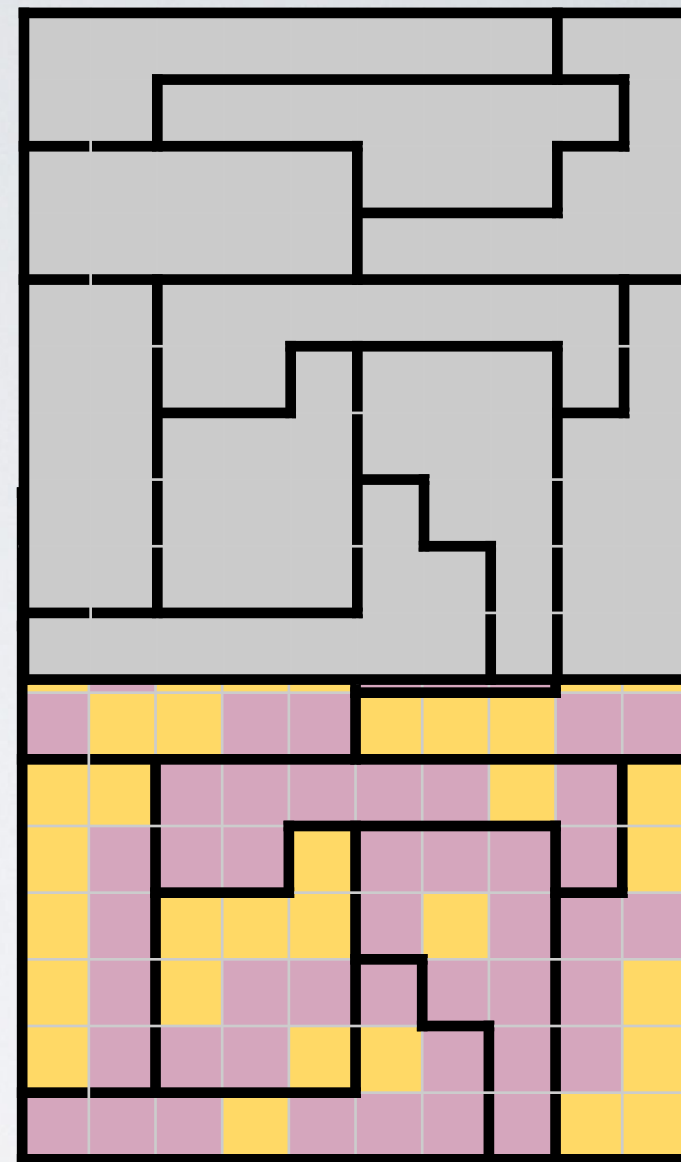
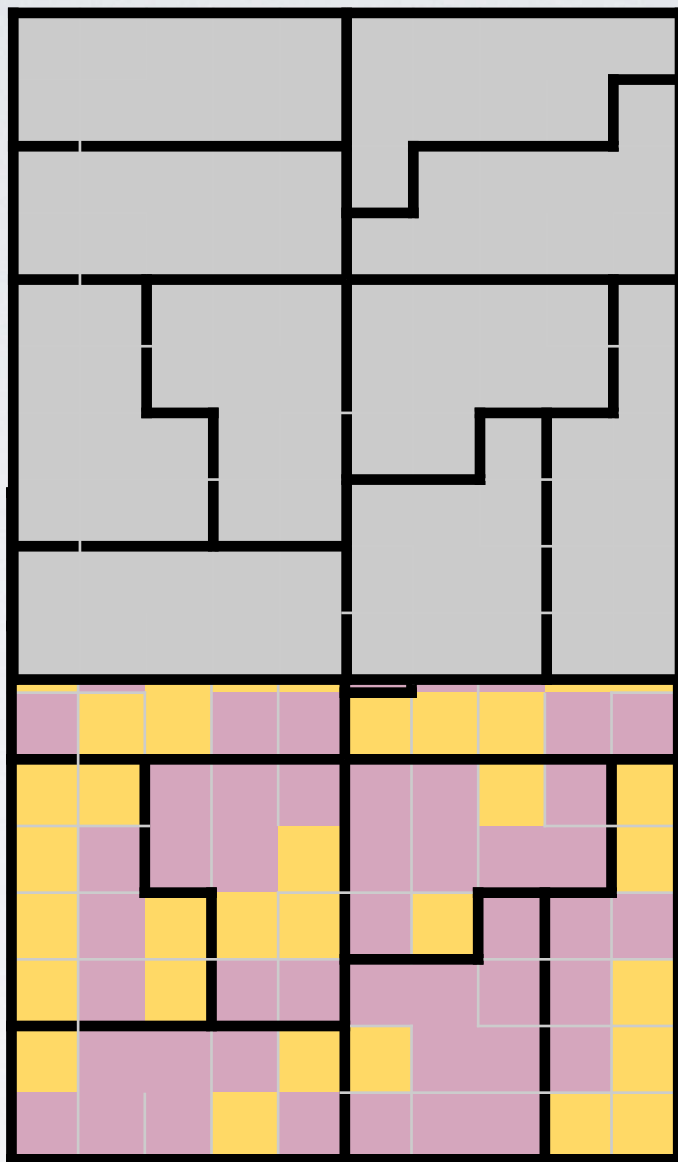
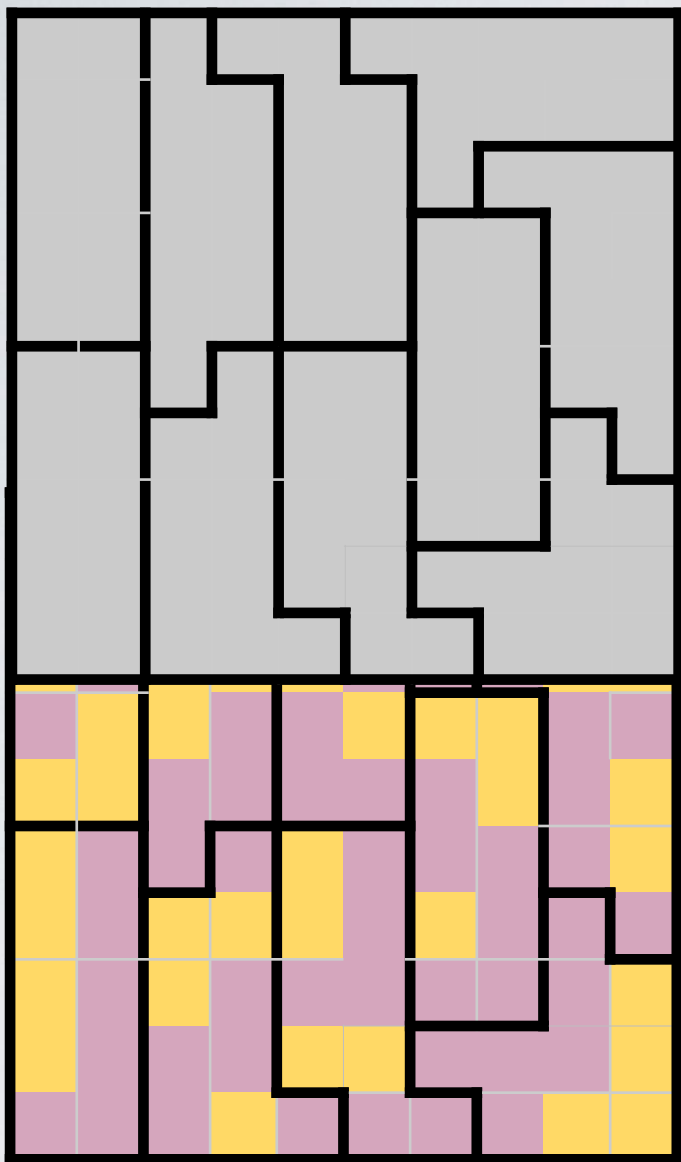
Key finding

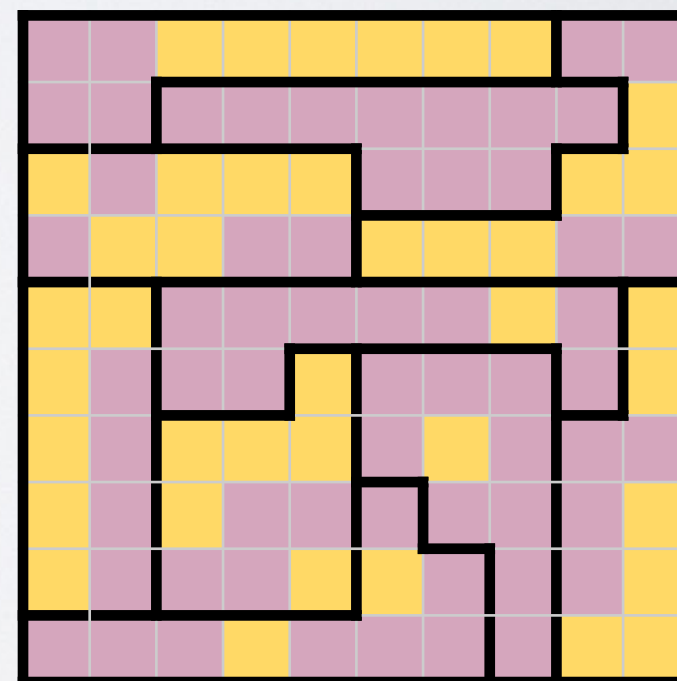
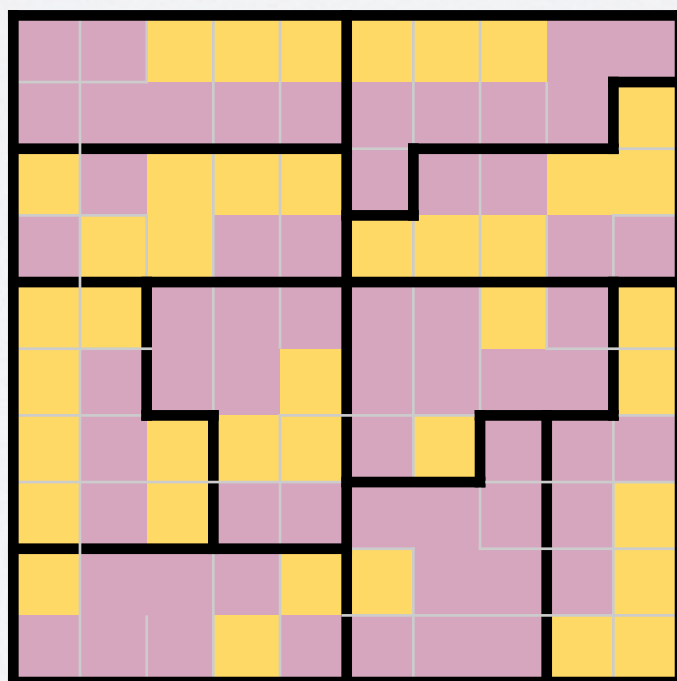
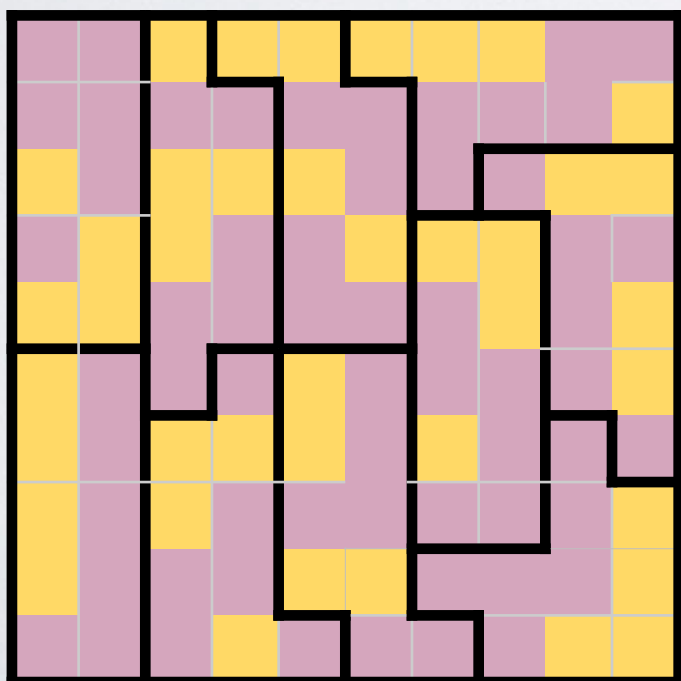
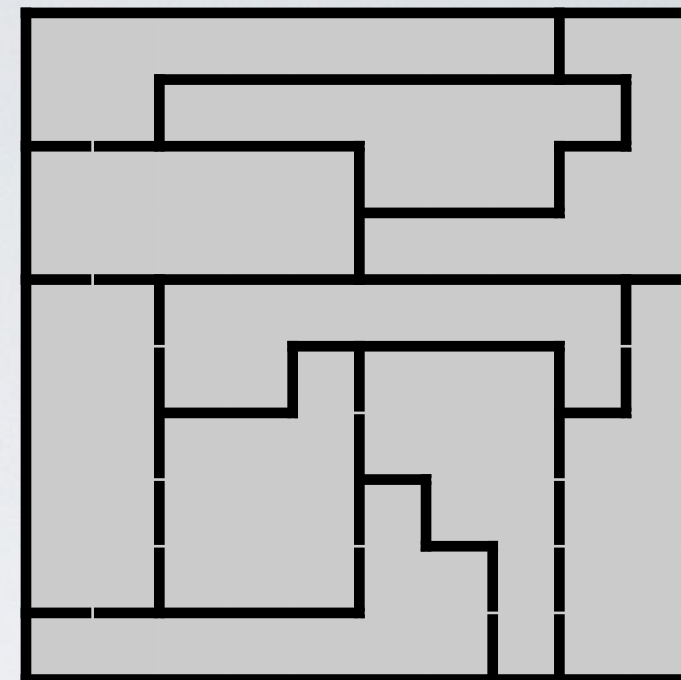
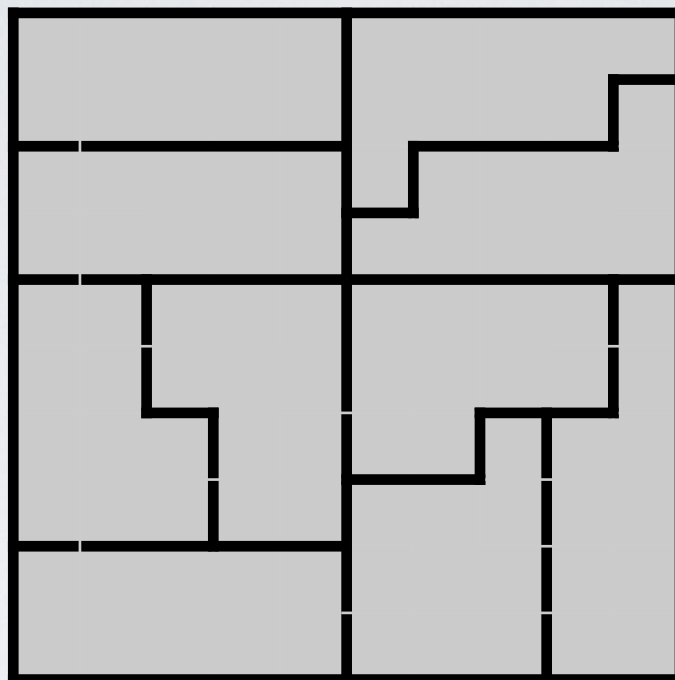
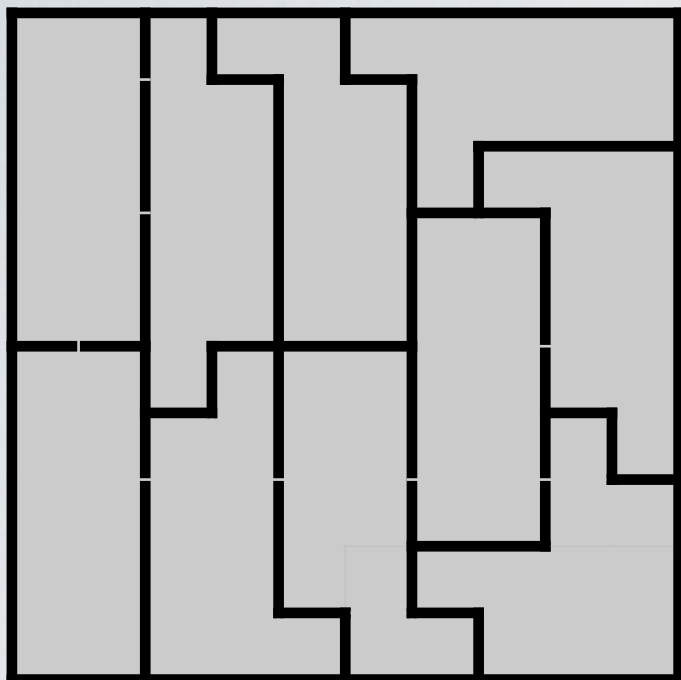
The normative story becomes clearer when you separate (a) *the absence of gerrymandering* from (b) *partisan fairness*.

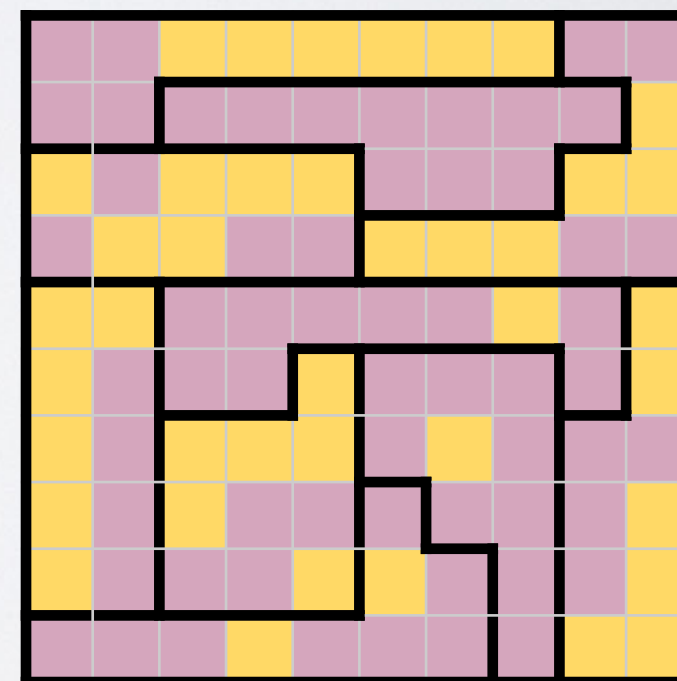
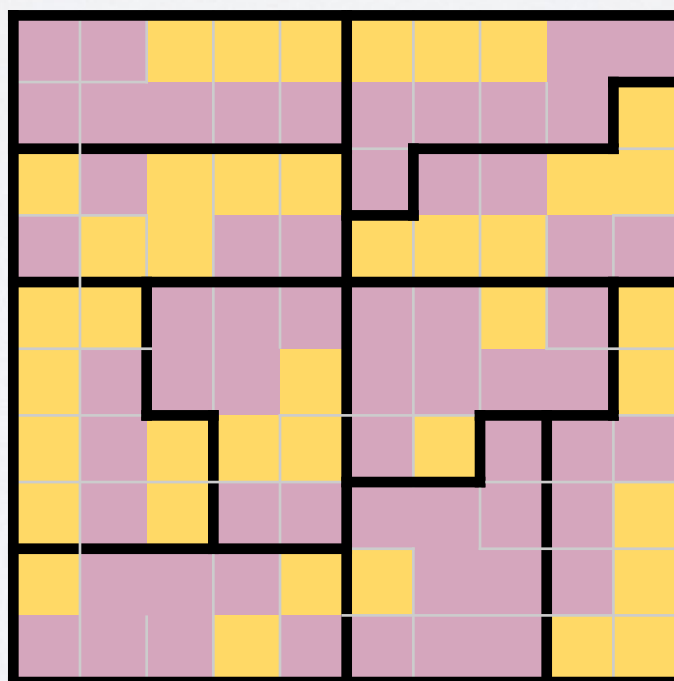
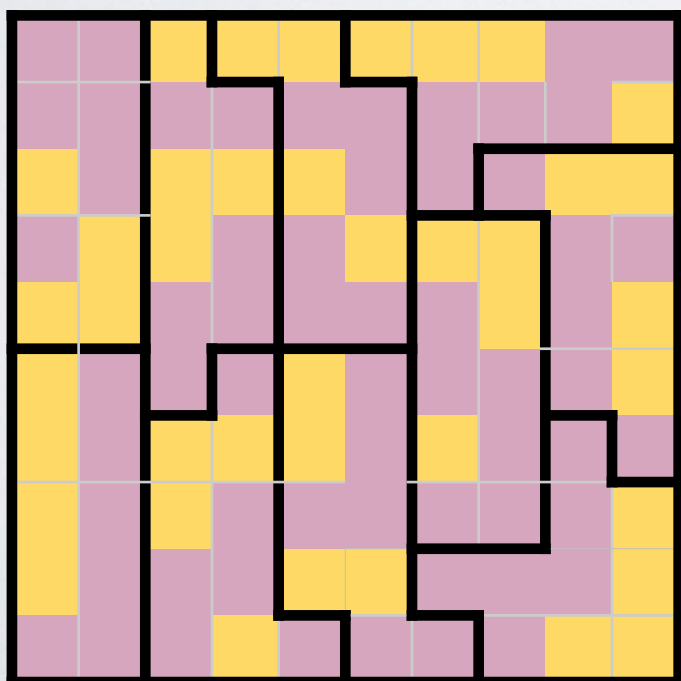
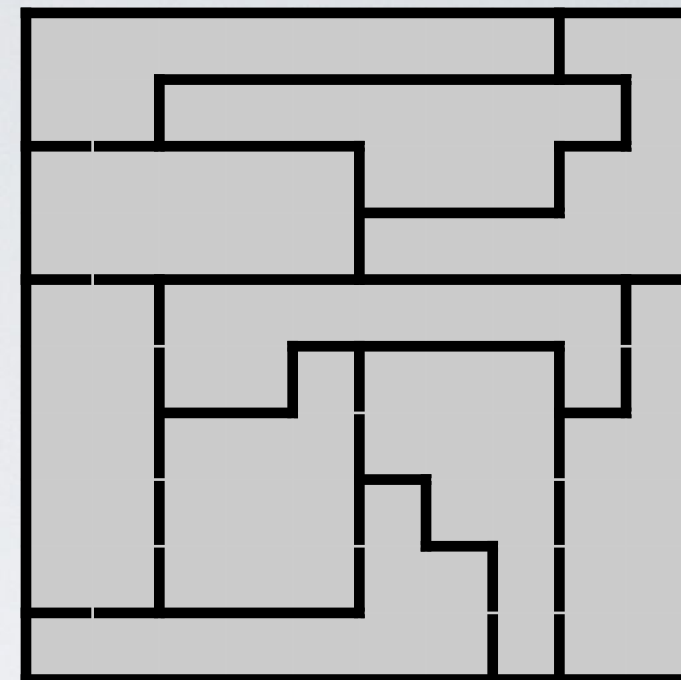
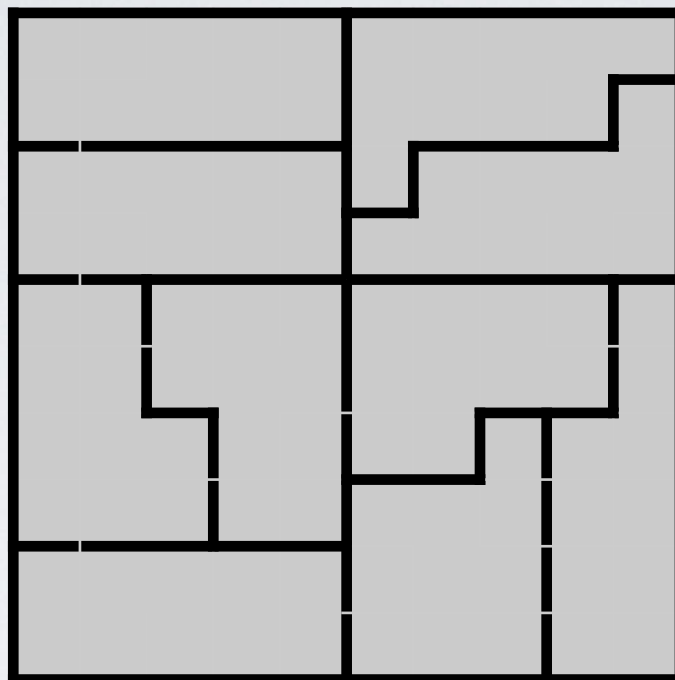
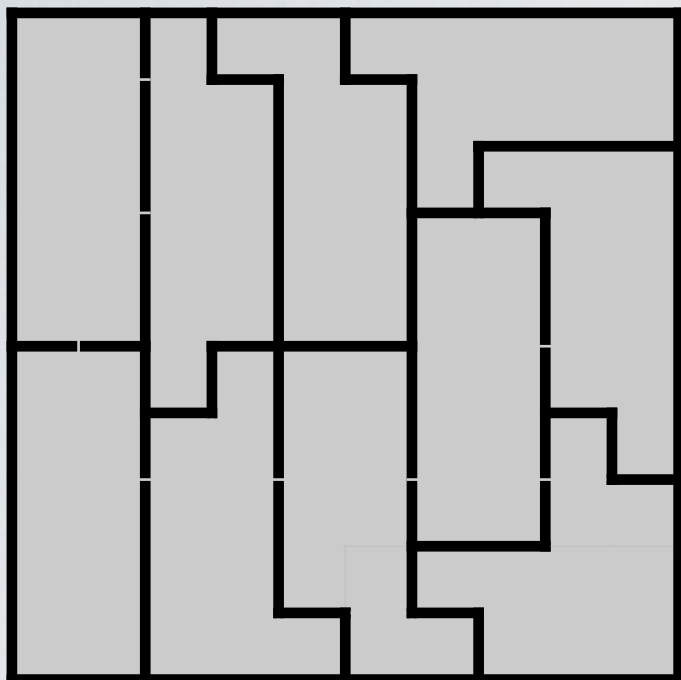
Illustration of the scope of the problem: a case with 40% orange voters where careful line-drawing can give them anywhere from 0% to 60% of the seats.



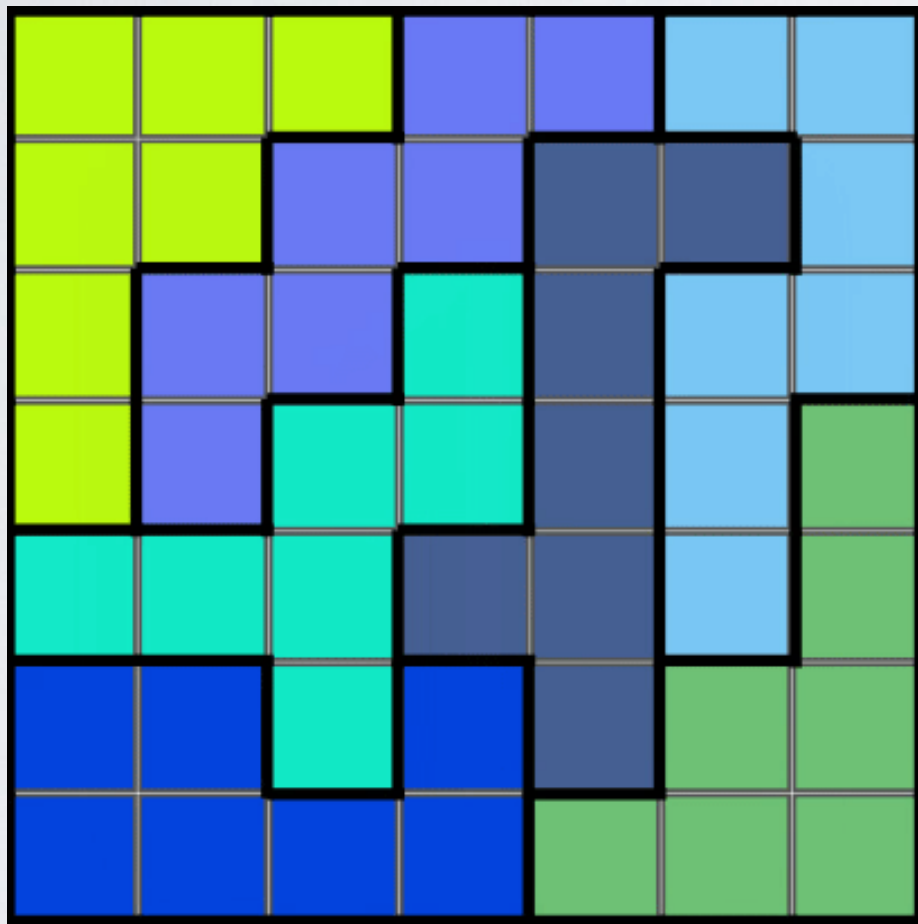








FINDING THE BASELINE

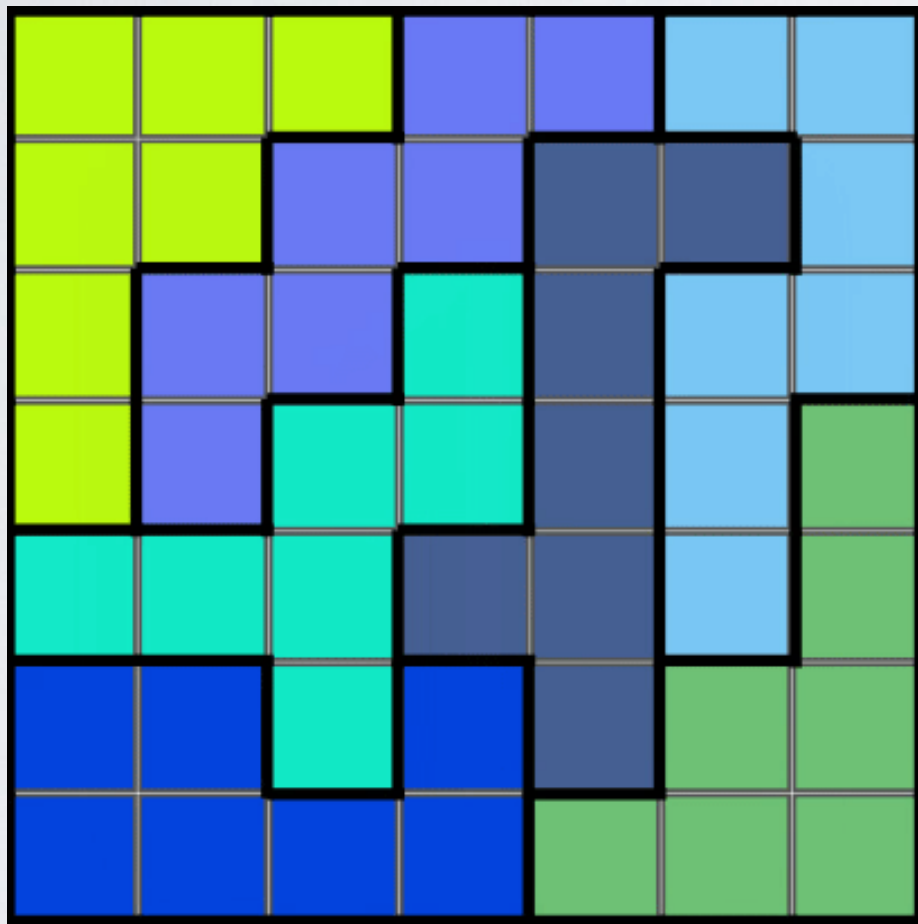


Explore with **Markov chain** that draws representative samples from the universe of compliant plans

Note that the universe is constructed/entailed by the rules

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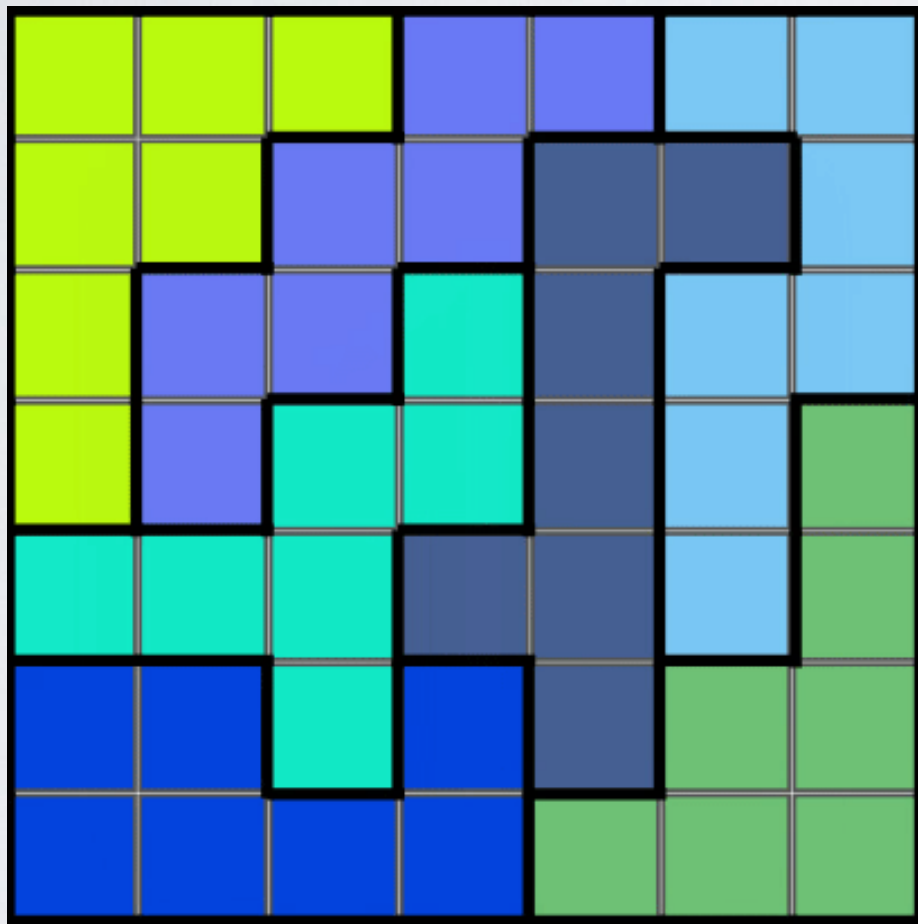


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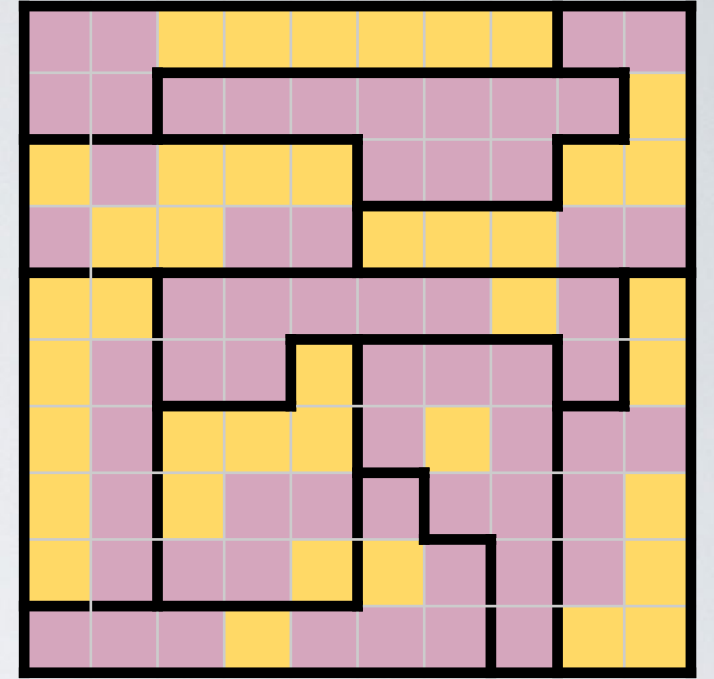
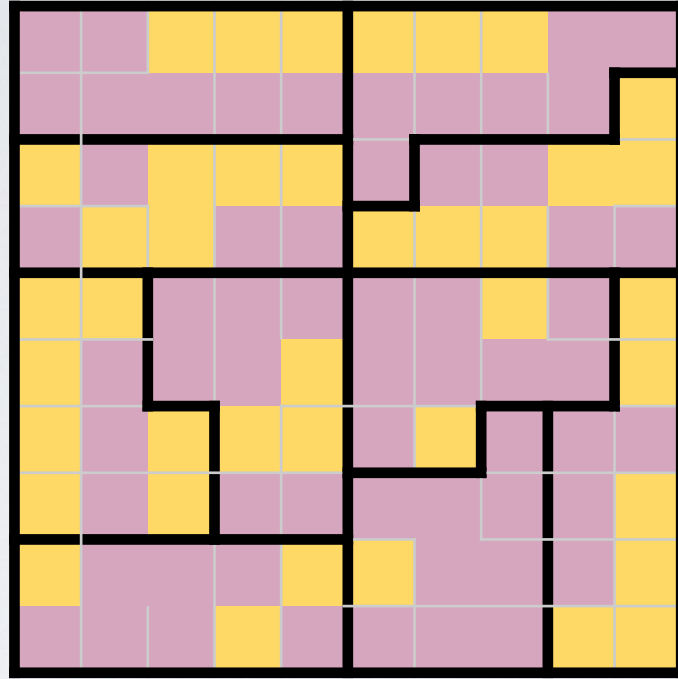
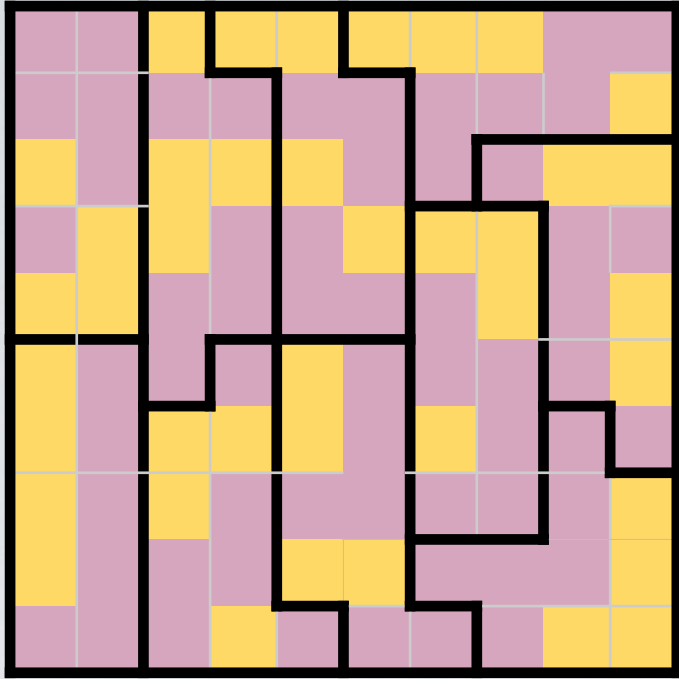
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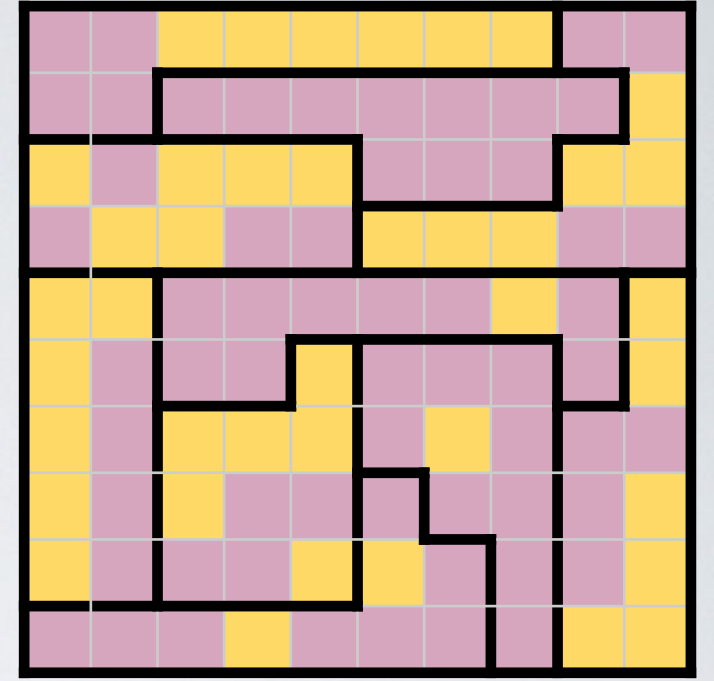
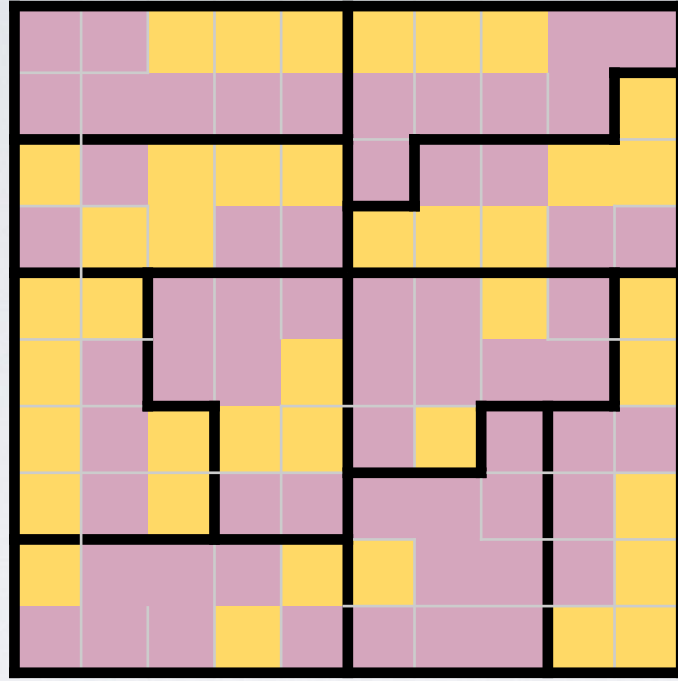
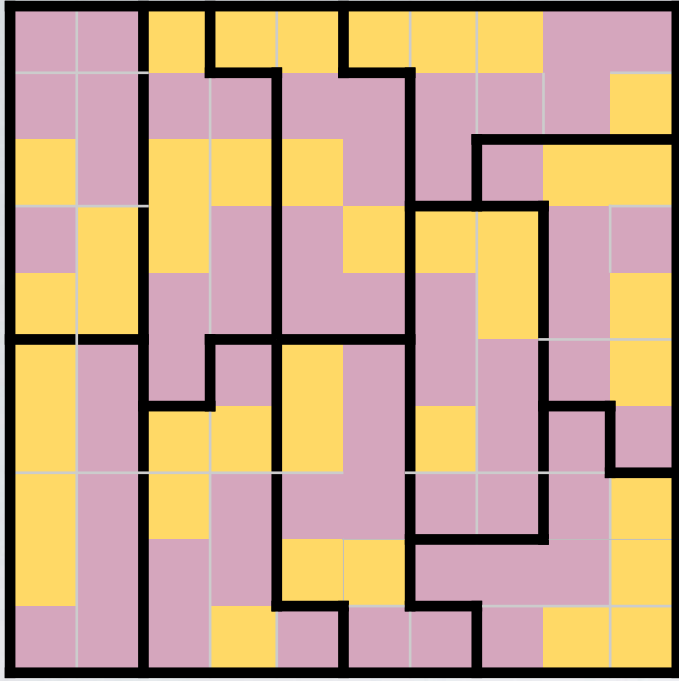


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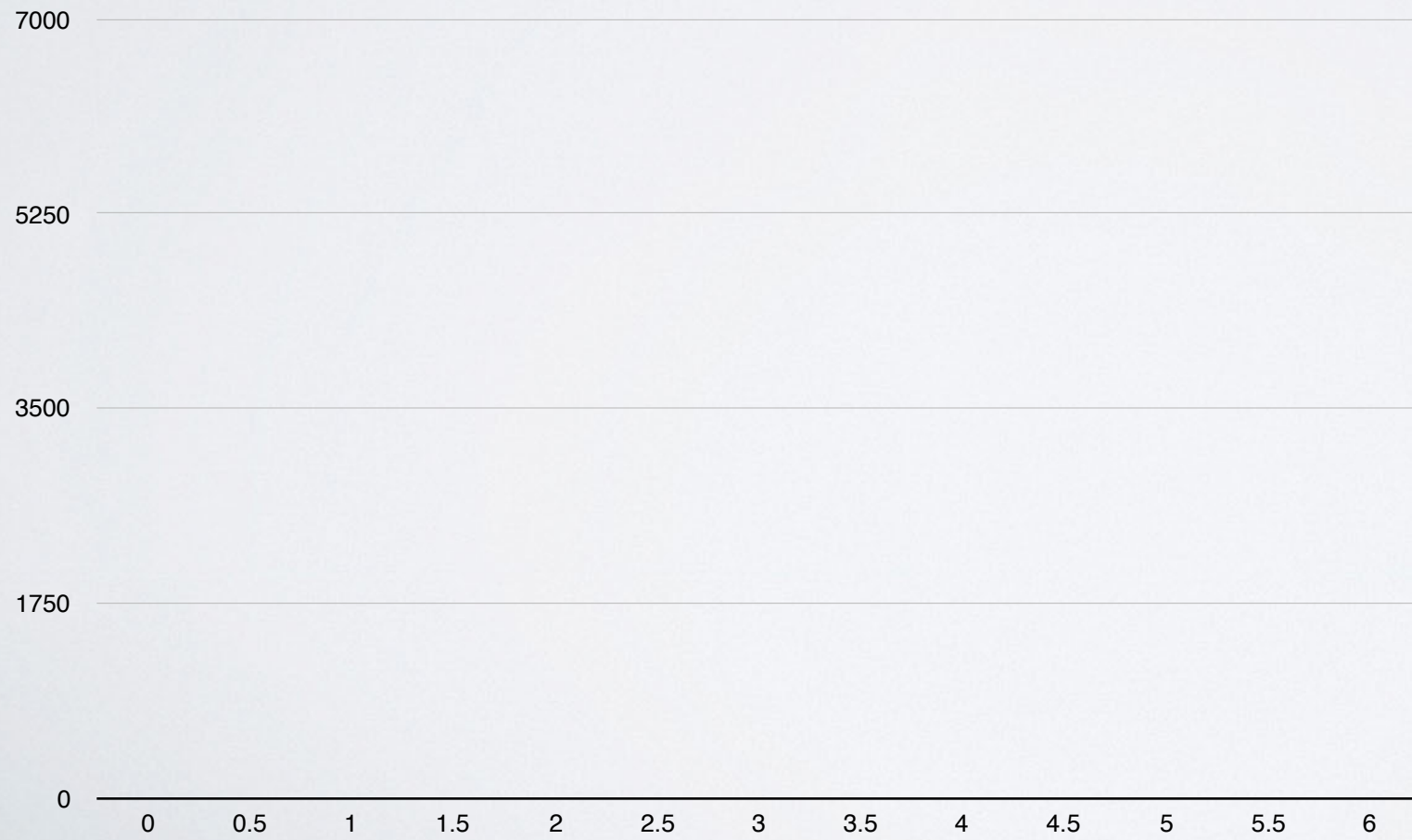


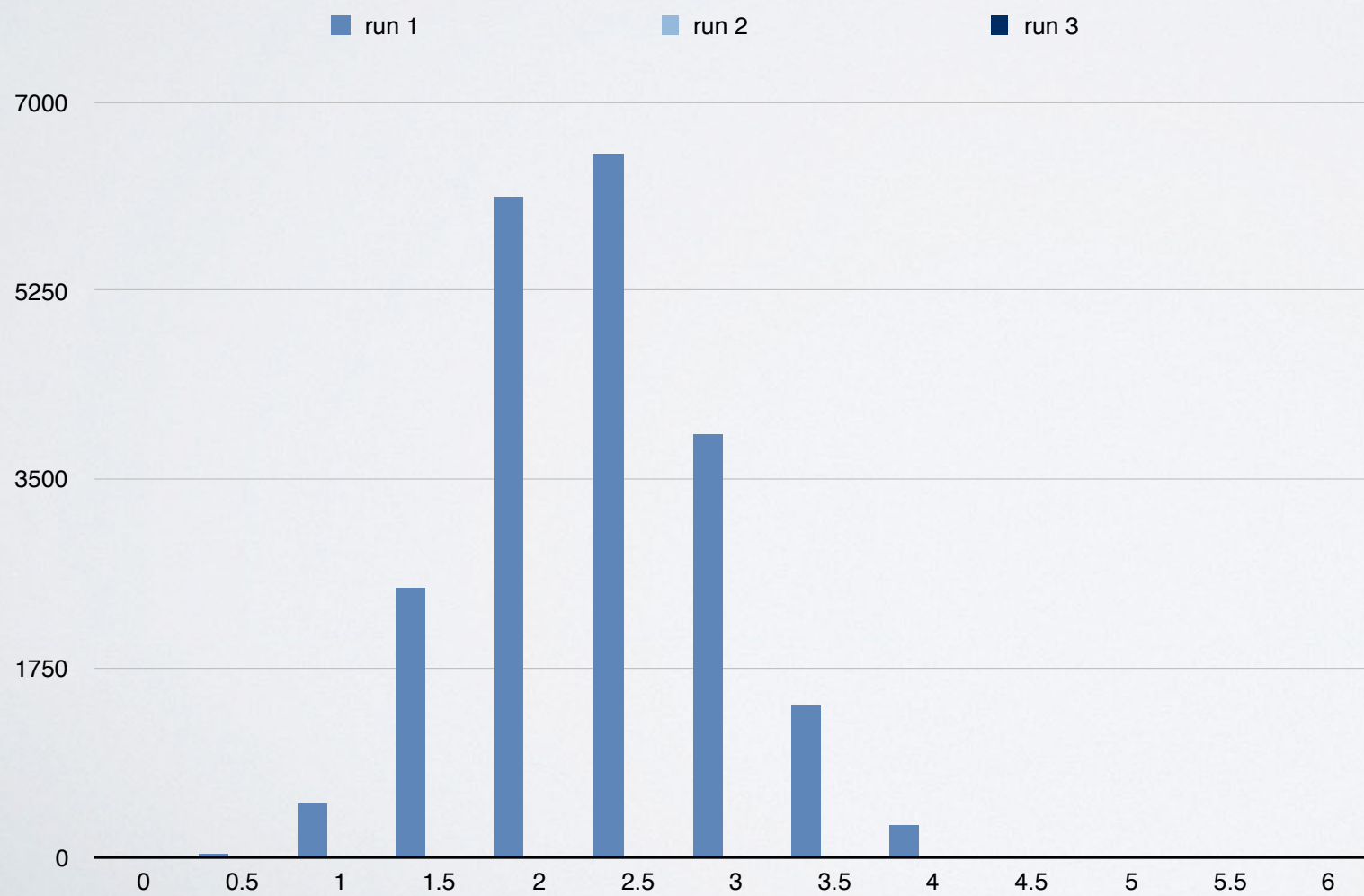
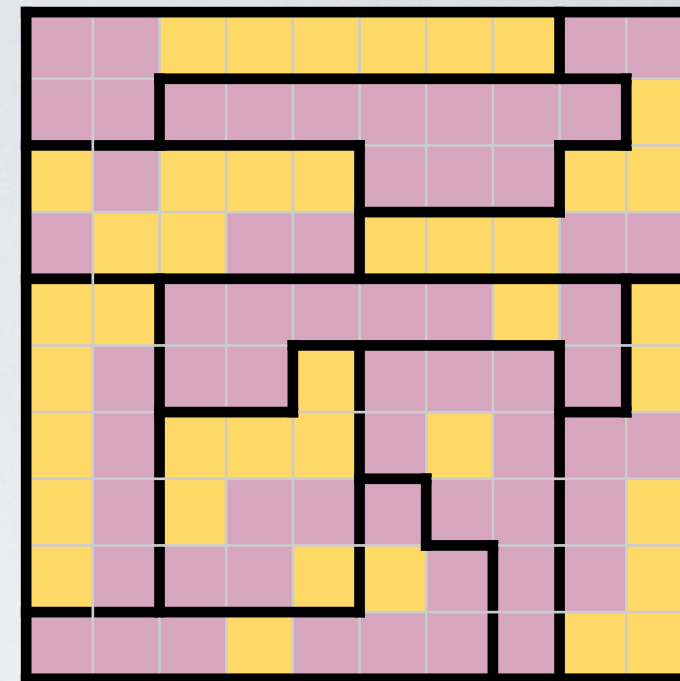
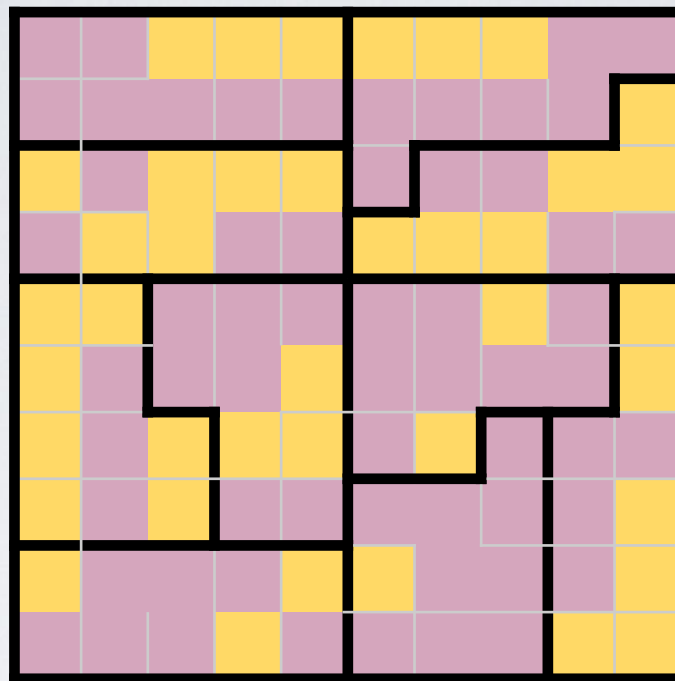
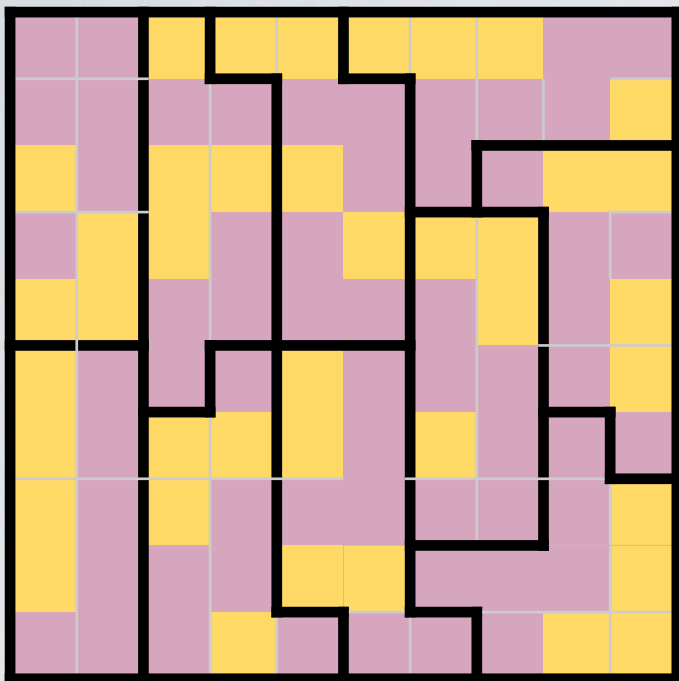


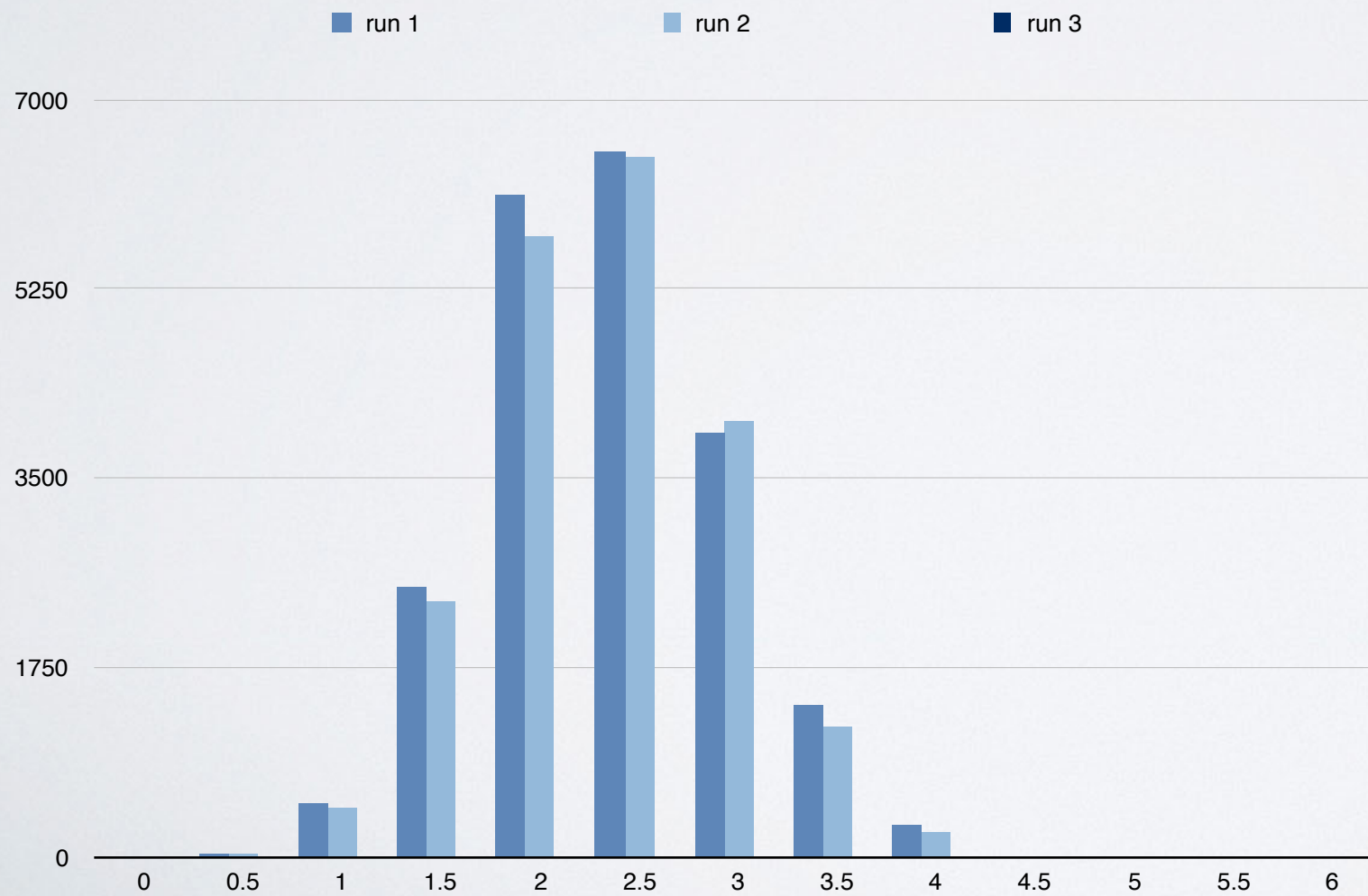
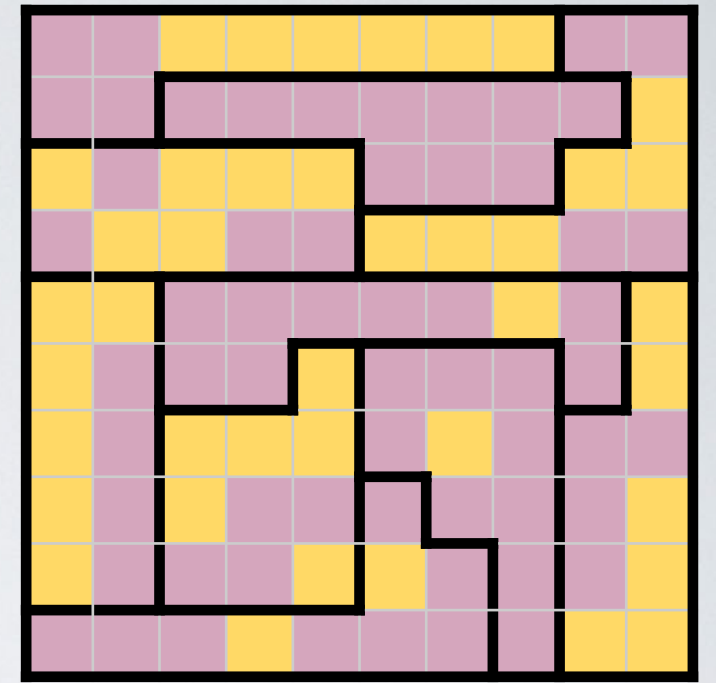
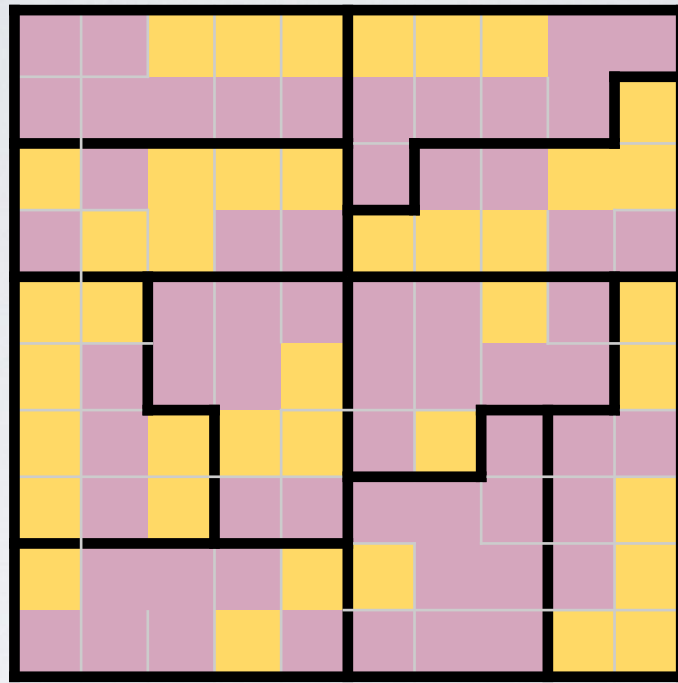
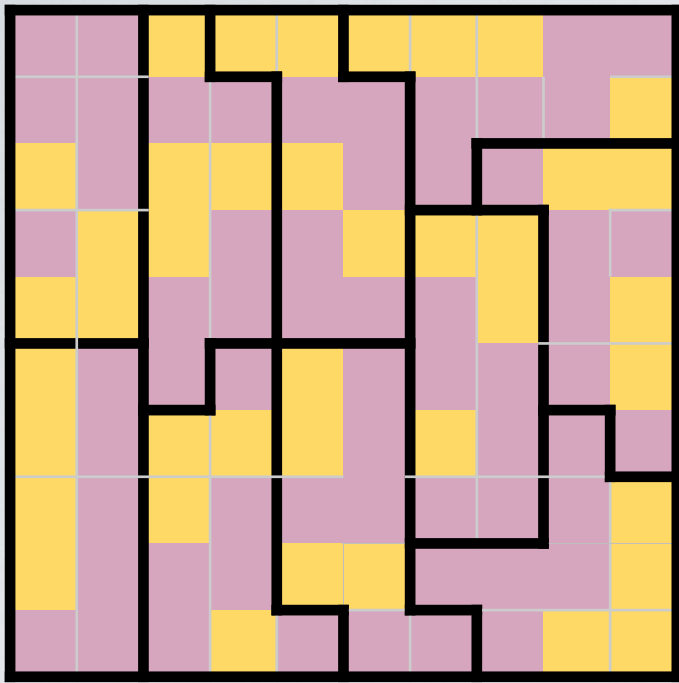
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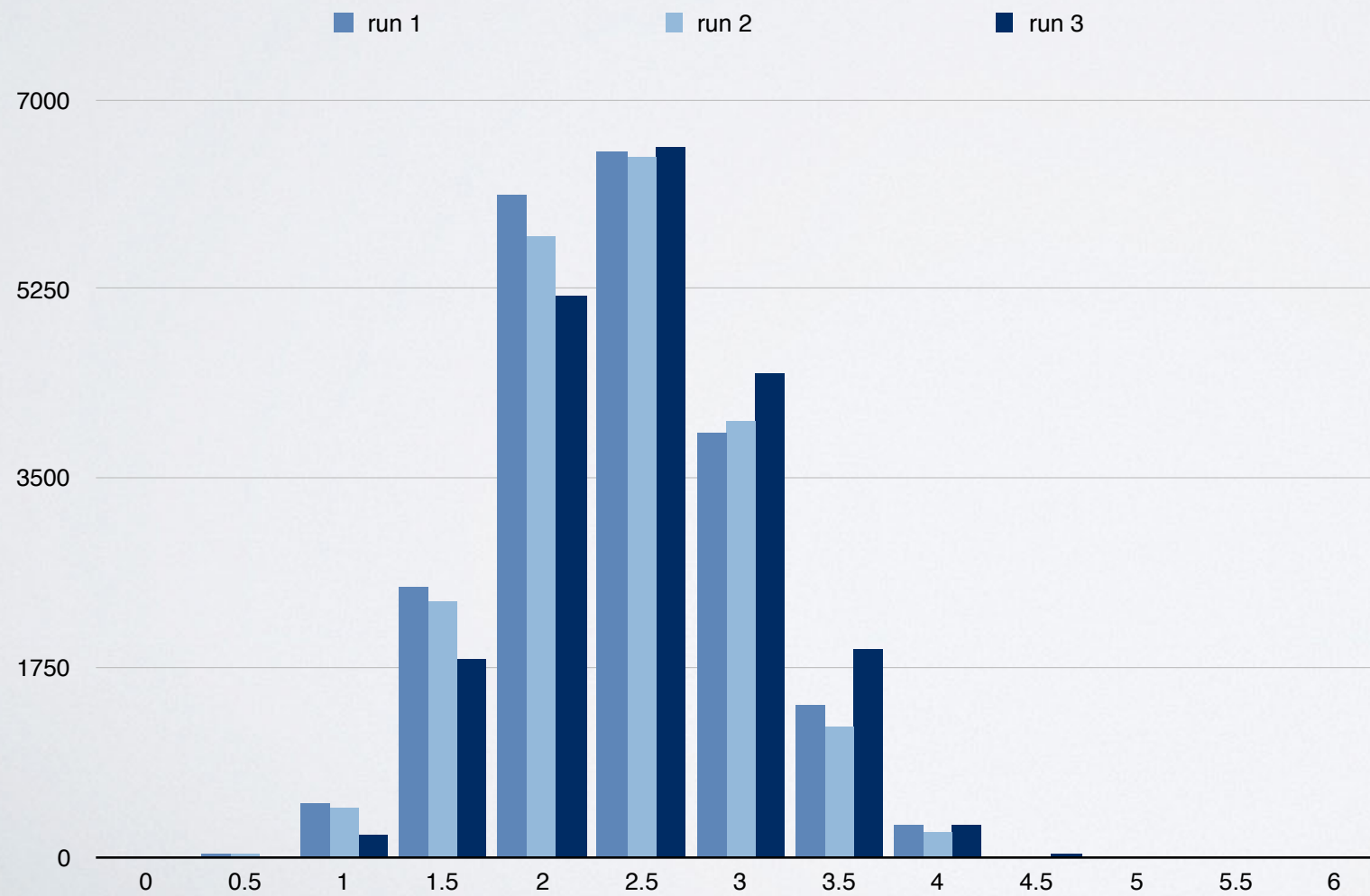
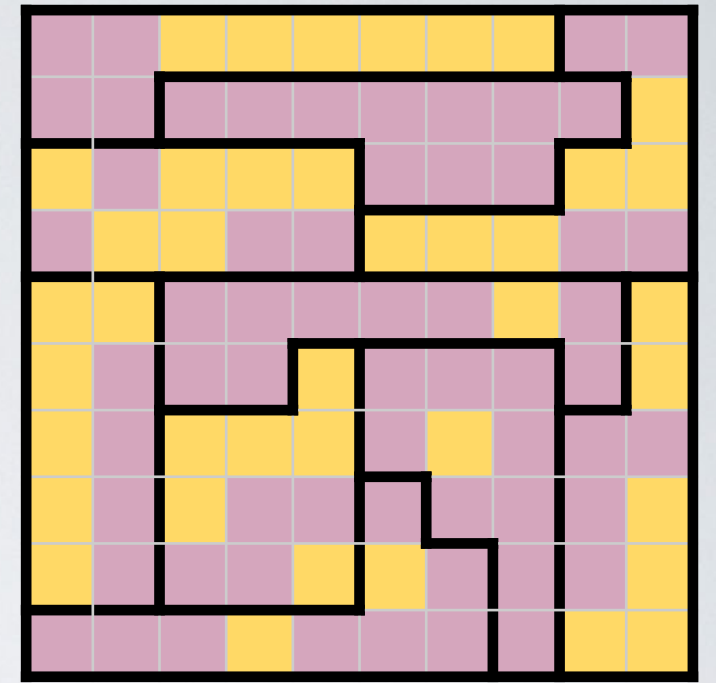
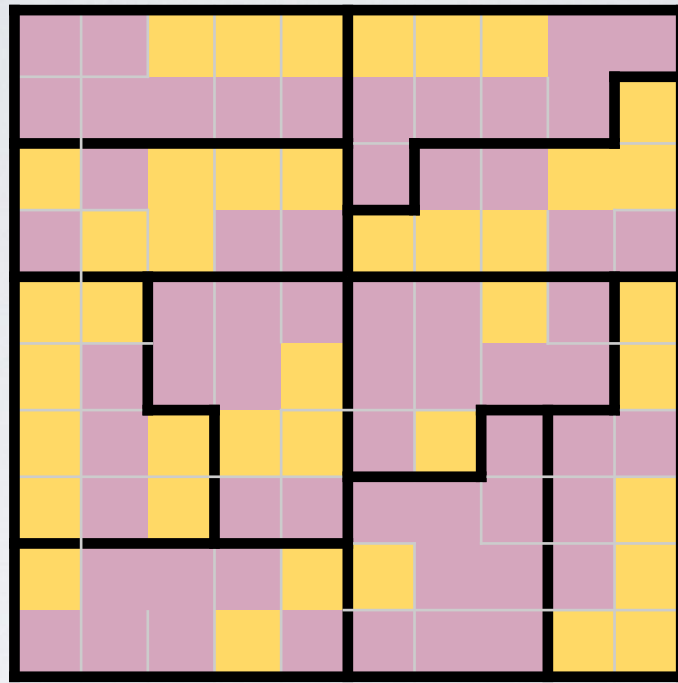
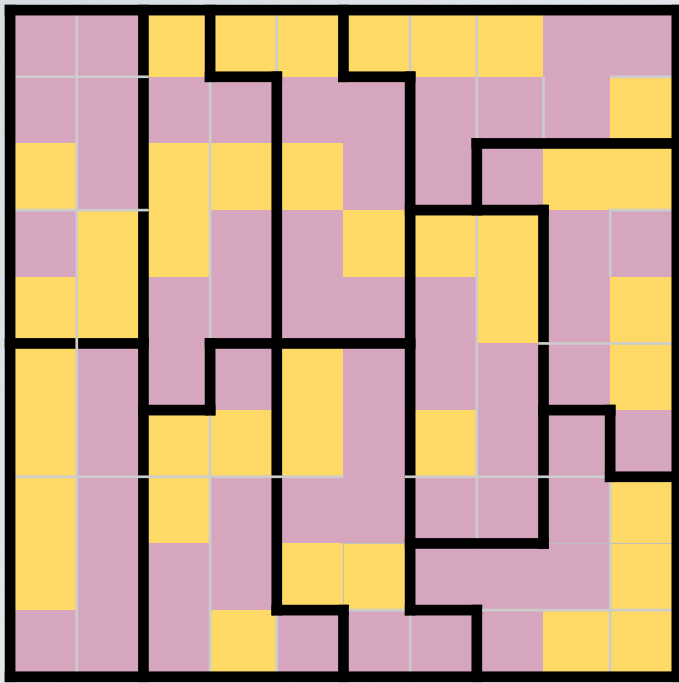
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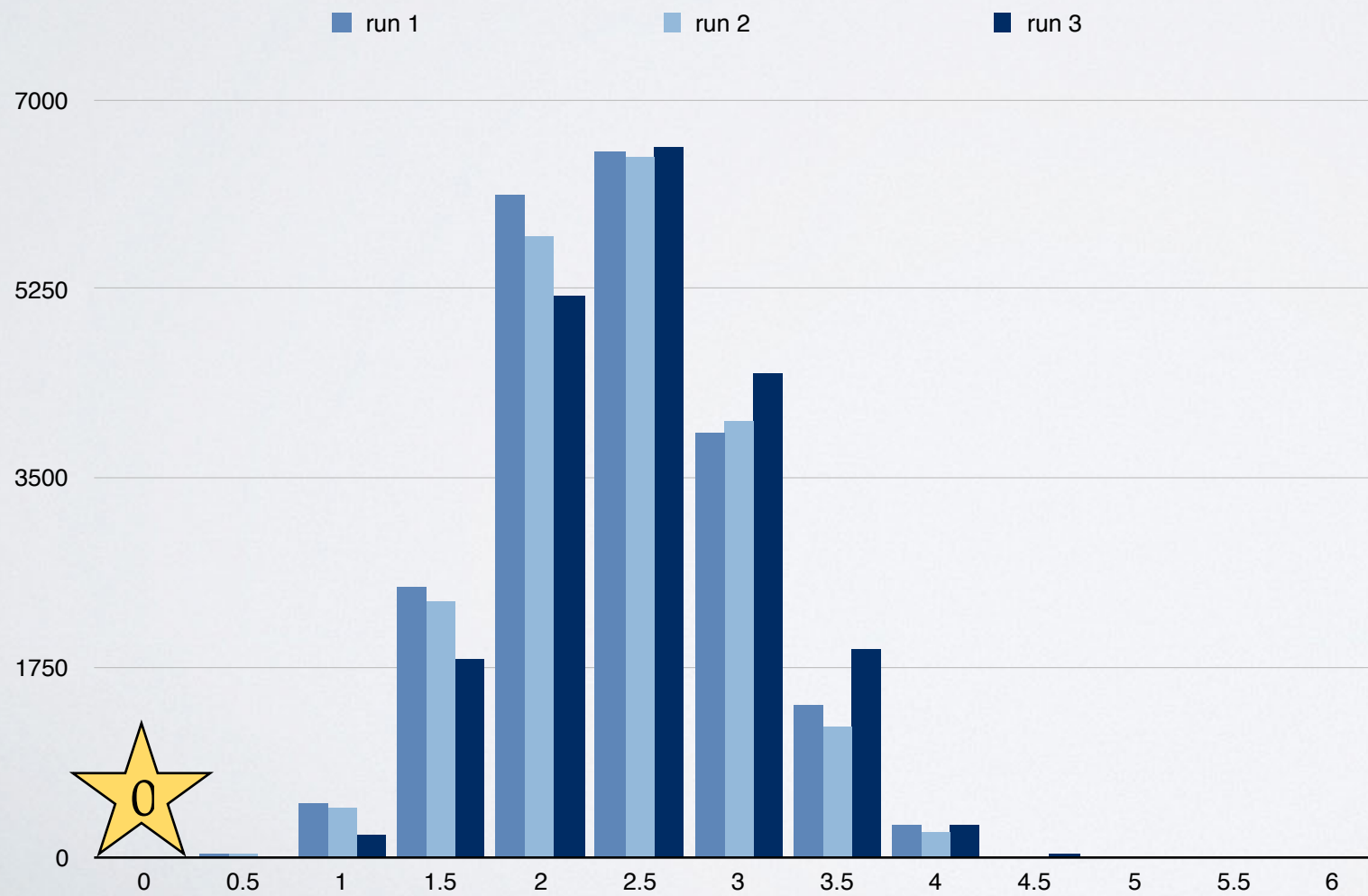
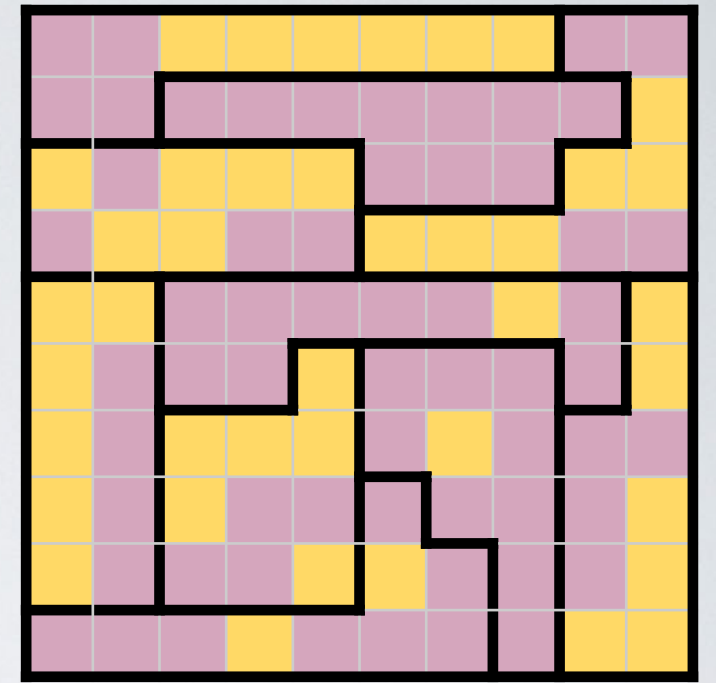
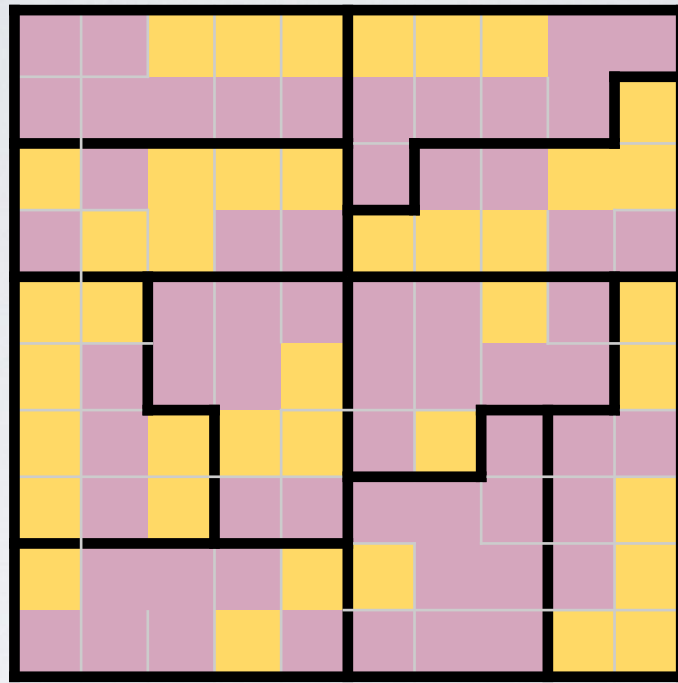
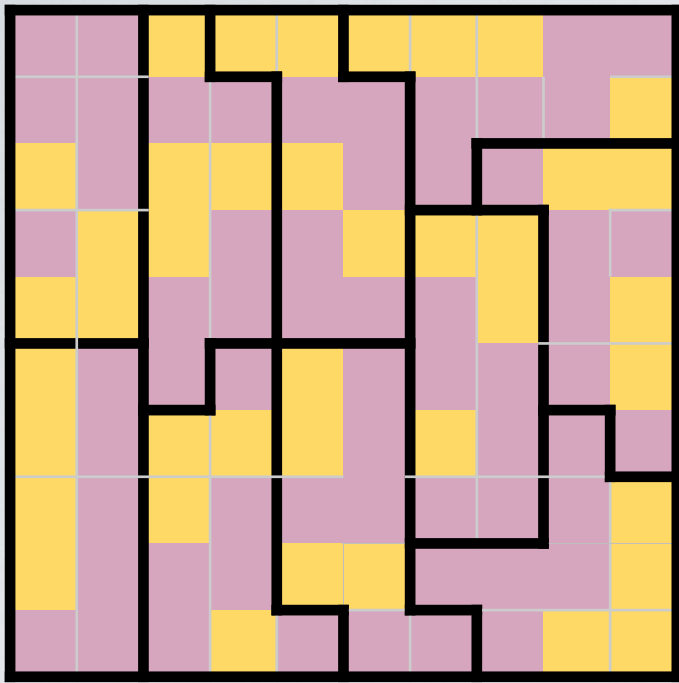
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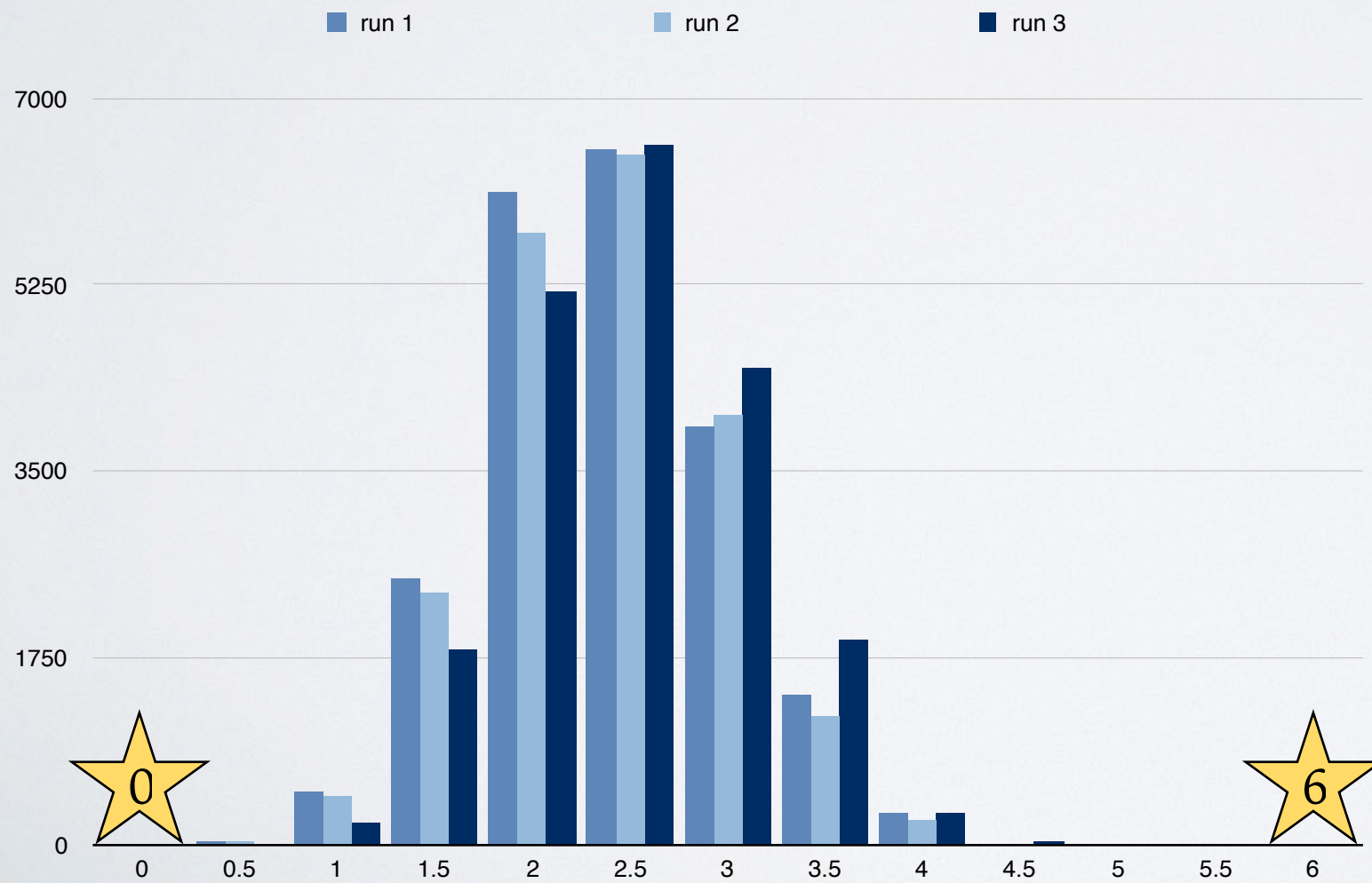
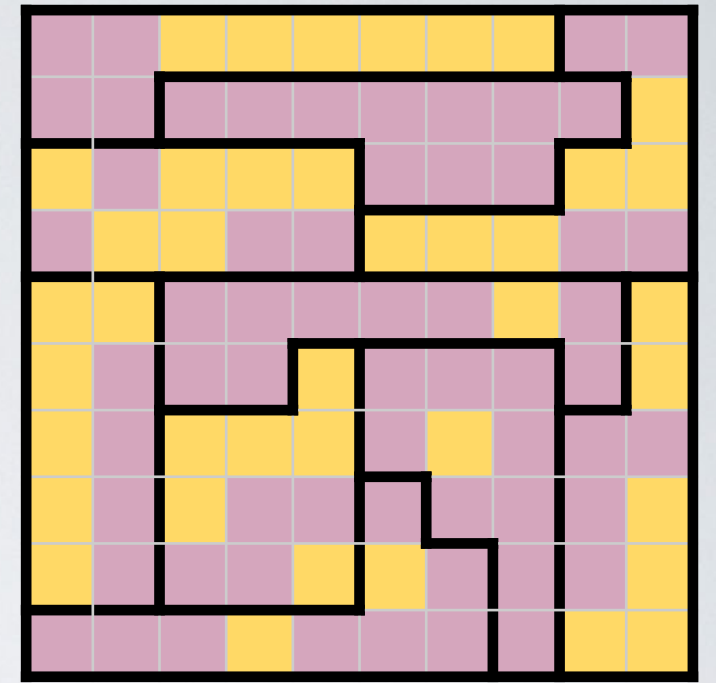
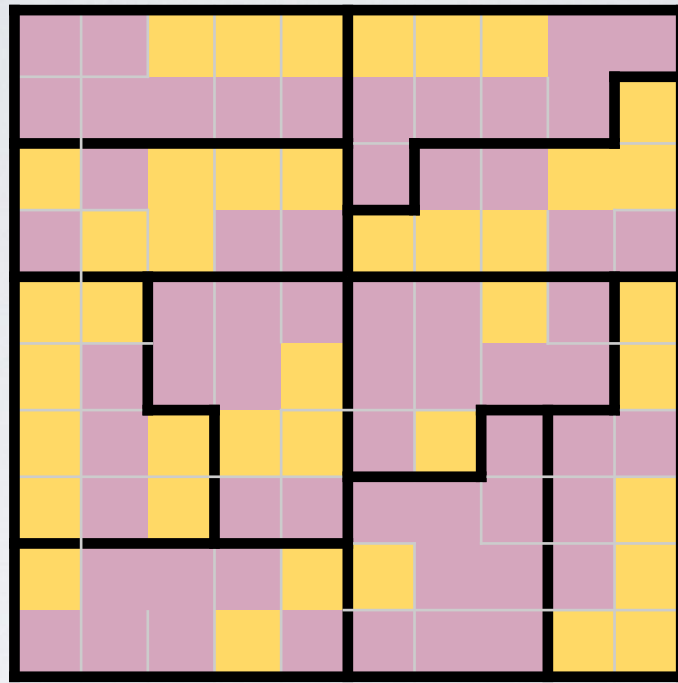
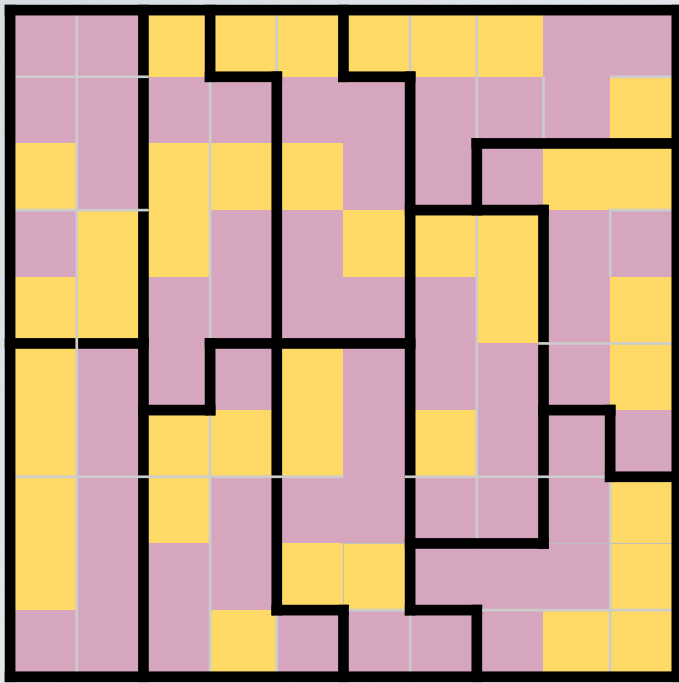


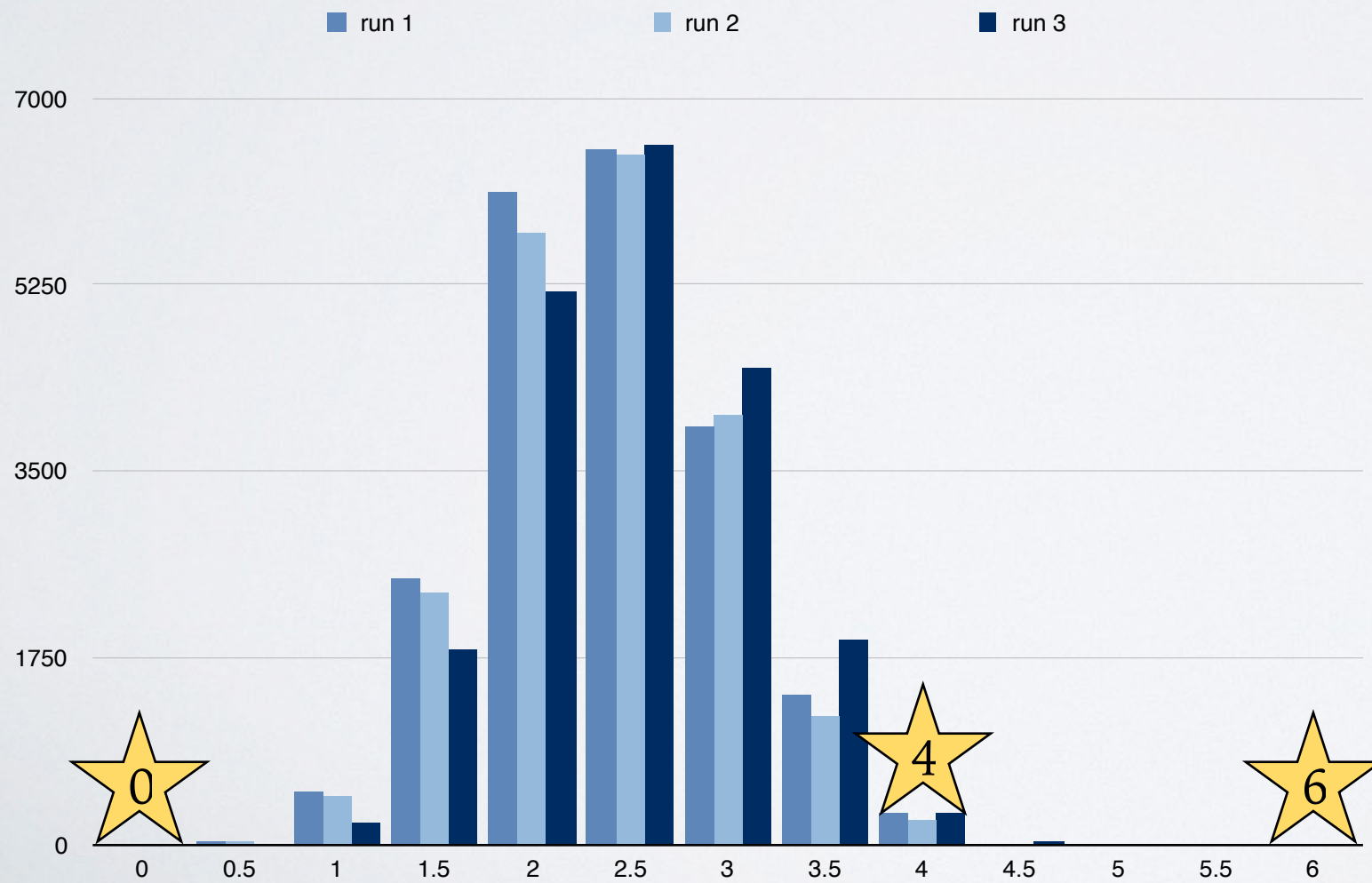
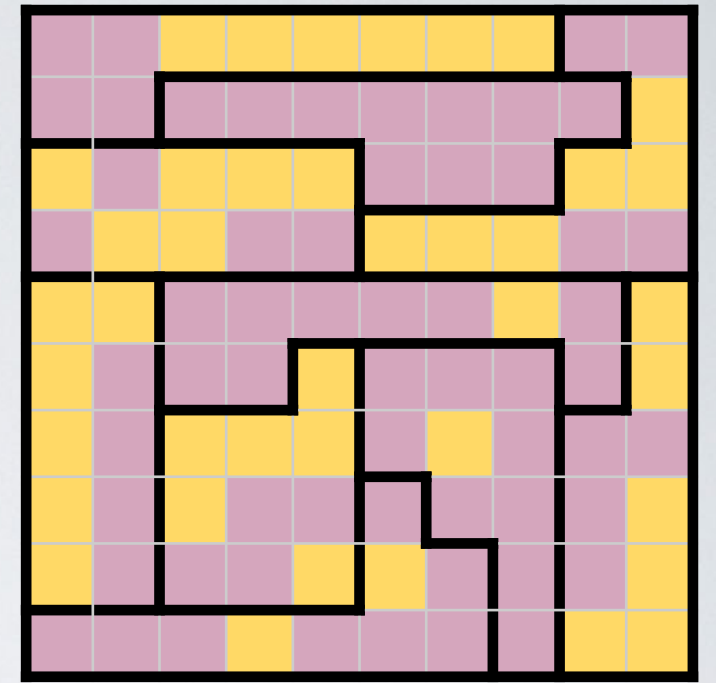
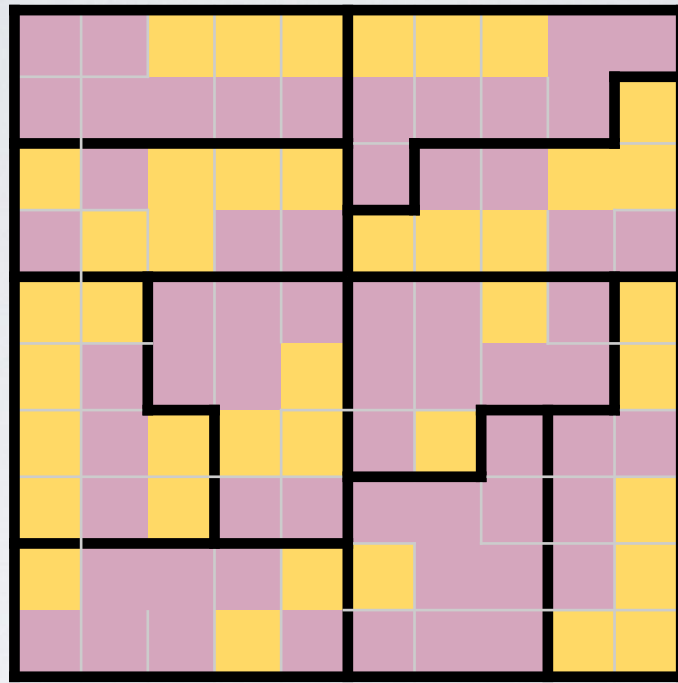
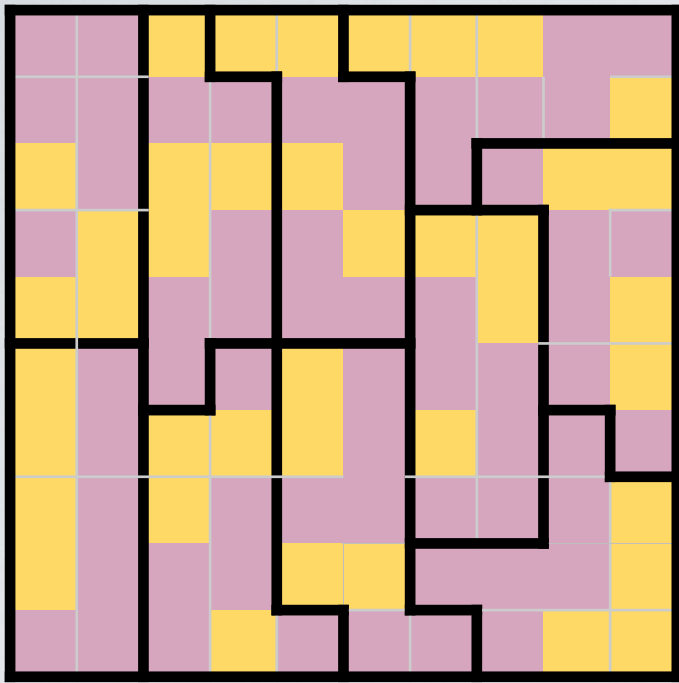


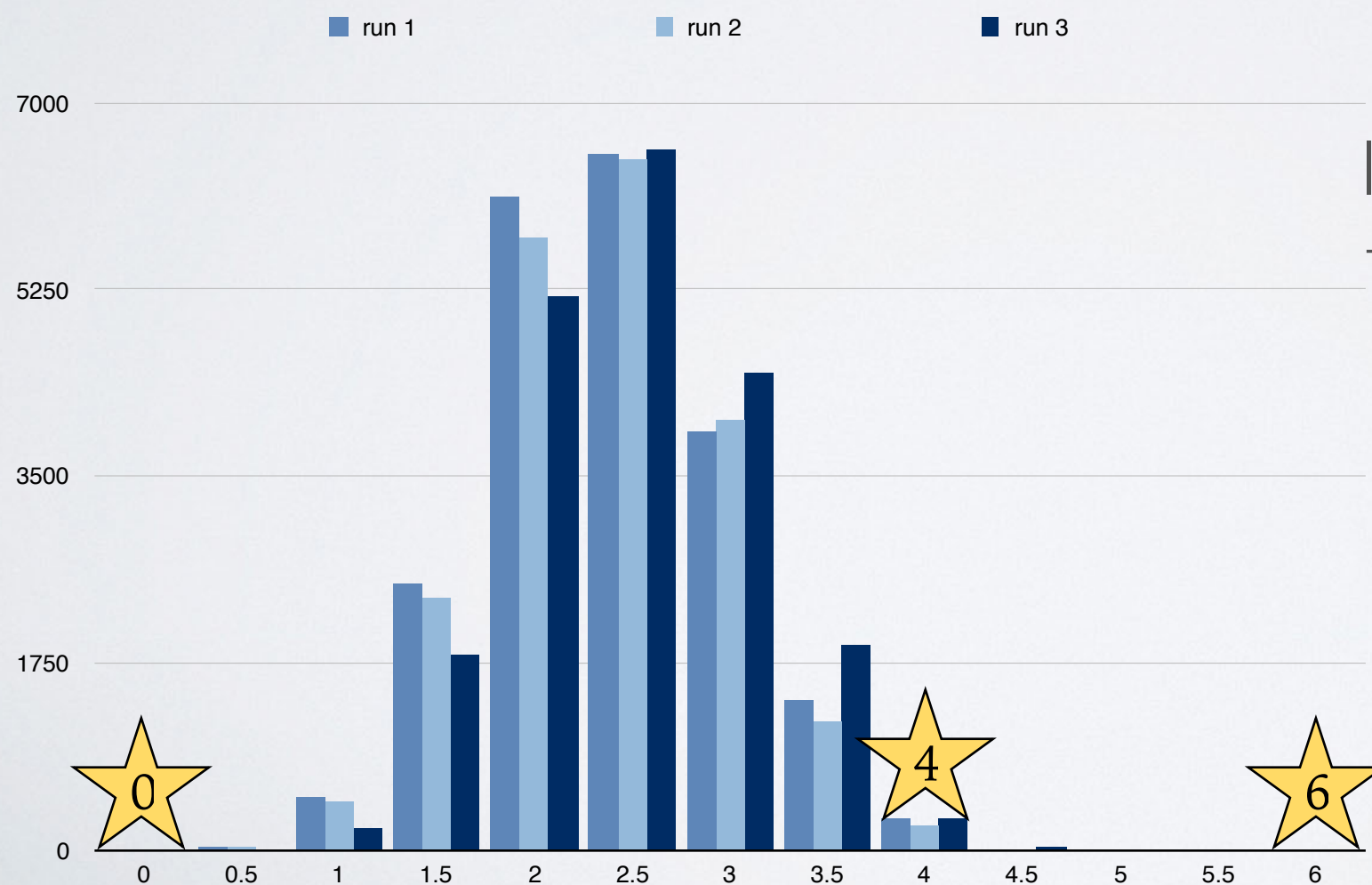
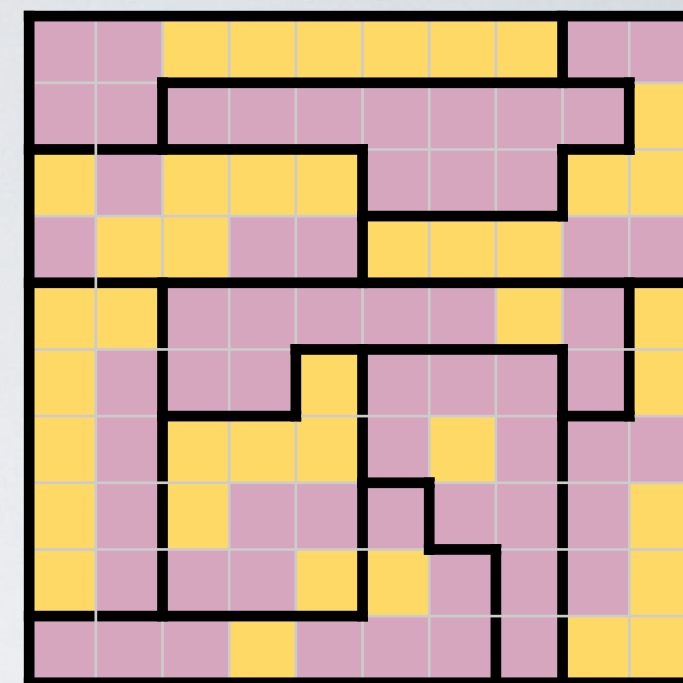
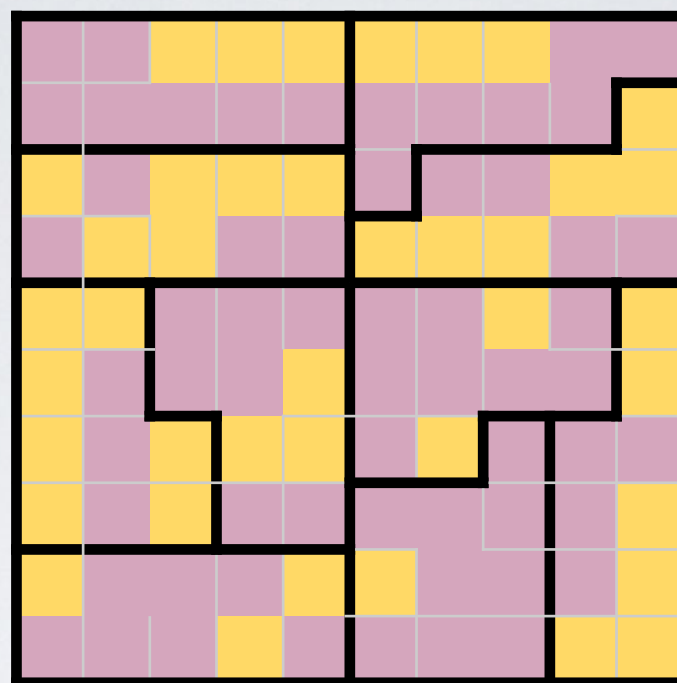
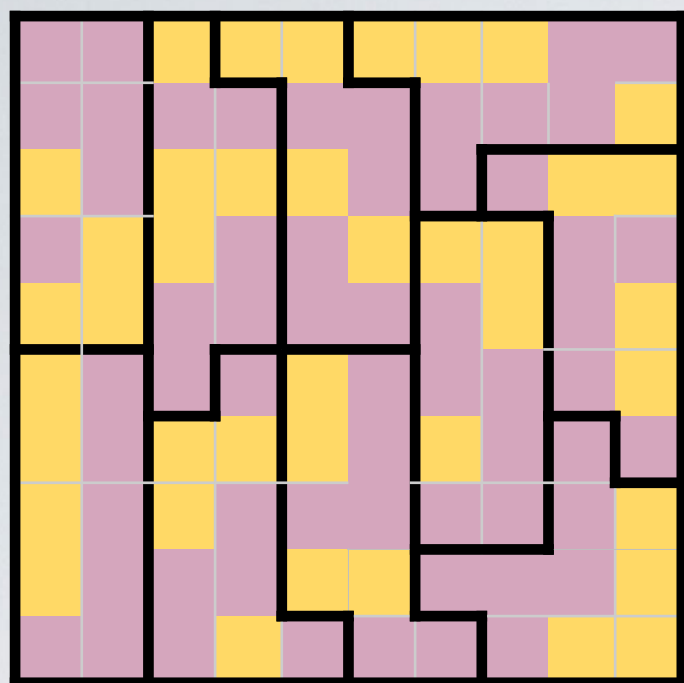












If you let the chips fall where they may, this particular 40% of voters will secure about 23% of seats.

PROPORTIONALITY

...not what we ordered

PROPORTIONALITY

...not what we ordered

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21	prongs [4] 22:5 58:14,16 59:22	realistic
	proof [1] 45:21	reality [2]
	proportional [46] 9:20 10:18 26:	really [13]
	10,16,23 27:8,13,24 28:10,18 29:8	14 25:23
	31:4,17 32:24 33:11,18,20 37:14,	64:6 69:1
	15 38:1,5 44:7,11 45:22 46:3,11,	reason [6]
	17 47:2,11 59:17,18 60:1,6,14 61:	12 54:15
	6,18 62:24 63:16,19 65:5,24 66:4,	reasonable
	8,12,20,21	53:1 63:6
	proportionate [1] 9:24	reassign
	proposed [1] 67:12	REBUTT
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...not what we ordered

Jordan Ellenberg in Slate

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	proposing [3] 9:23 39:16 48:17	recent [1]



COUNSEL: I'd like a grilled cheese.

ALITO: OK, one tuna melt.

COUNSEL: No, I said grilled cheese.

KAVANAUGH: I hear the tuna melt's good.

GORSUCH: You want that tuna melt open face or closed?

COUNSEL: I don't want a tuna melt, I want a—

GORSUCH: It seems like you don't want to just come out and say it, but don't you want a tuna melt?

COUNSEL: No!

KAGAN: She asked for a grilled cheese. That's not a tuna melt because there's no tuna in it.

GORSUCH: But if, as you say, you don't want a tuna melt, what *do* you want? Are we supposed to just make up a sandwich for you?

ALITO: You come in here, you ask for a hot sandwich on toasted bread with cheese on it. To me, that's a tuna melt.

BREYER: Nobody ever orders the chopped liver, but have they really given it a chance?

OPPOSING COUNSEL: The framers had every opportunity to make you a tuna melt, but they chose not to.

IF NOT PROPORTIONALITY,
SOME OTHER METRIC?

Symmetry?
Efficiency gap?

Mean-Median (Gary King et al)

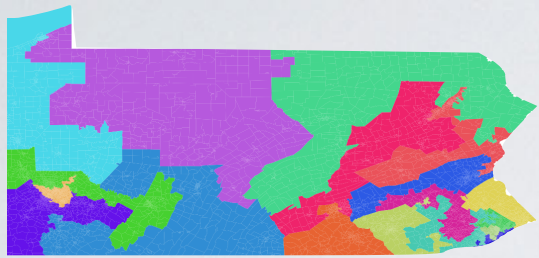
MM=0 means symmetry

MM=.03 said to mean Republicans could have secured 50% of seats with only 47% of votes

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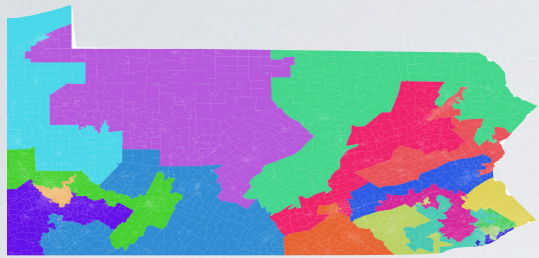


2011 plan
 $MM=.06$

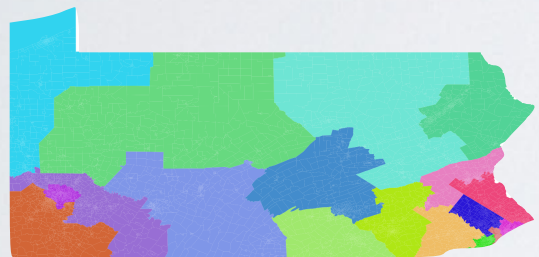
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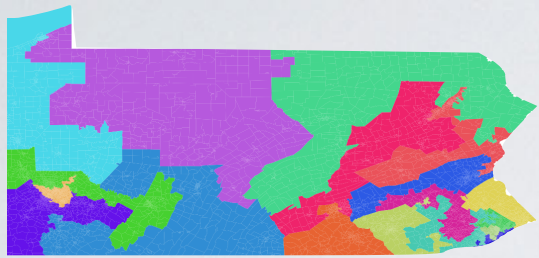


Gov plan
 $MM=.03$

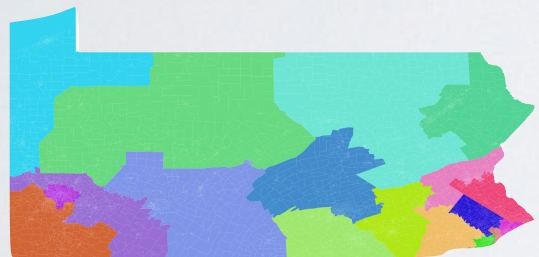
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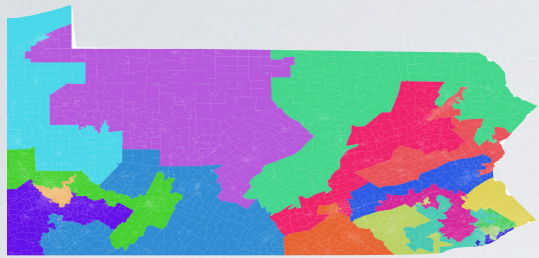
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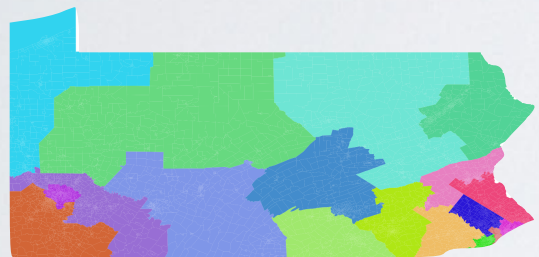
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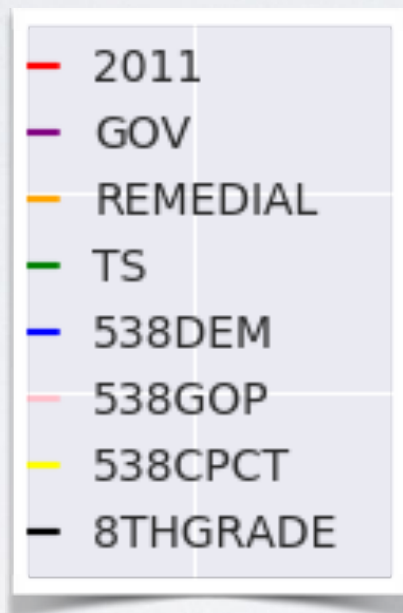


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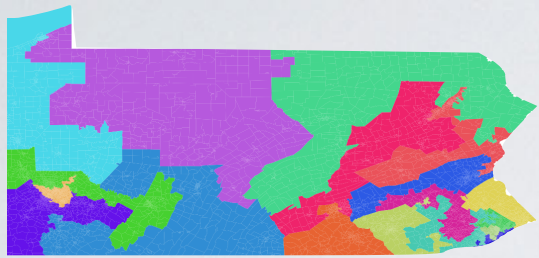
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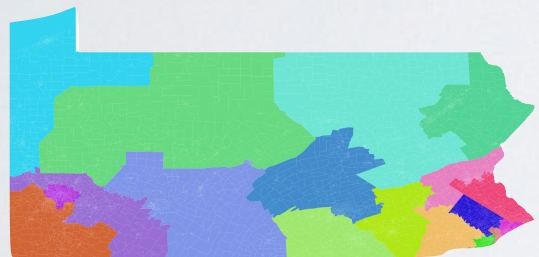
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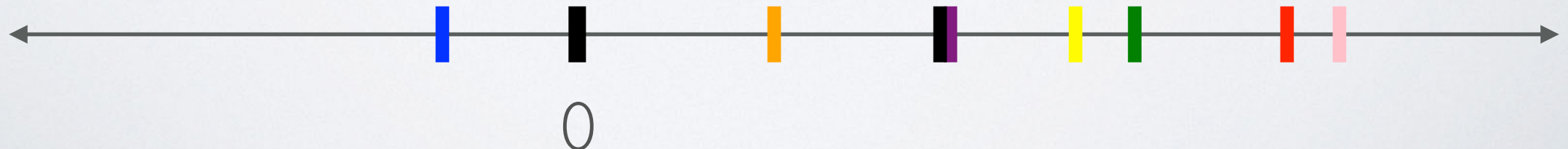
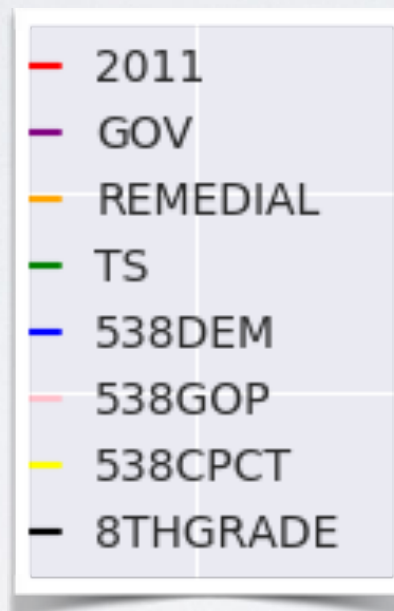


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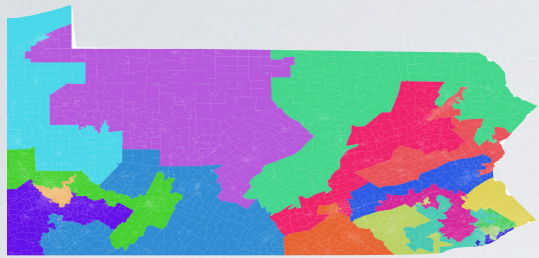
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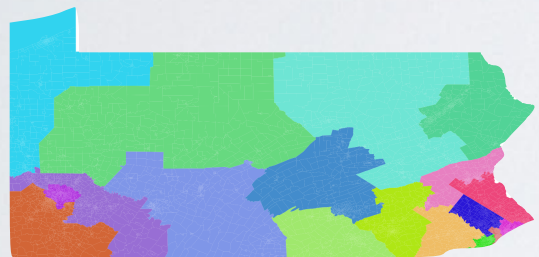
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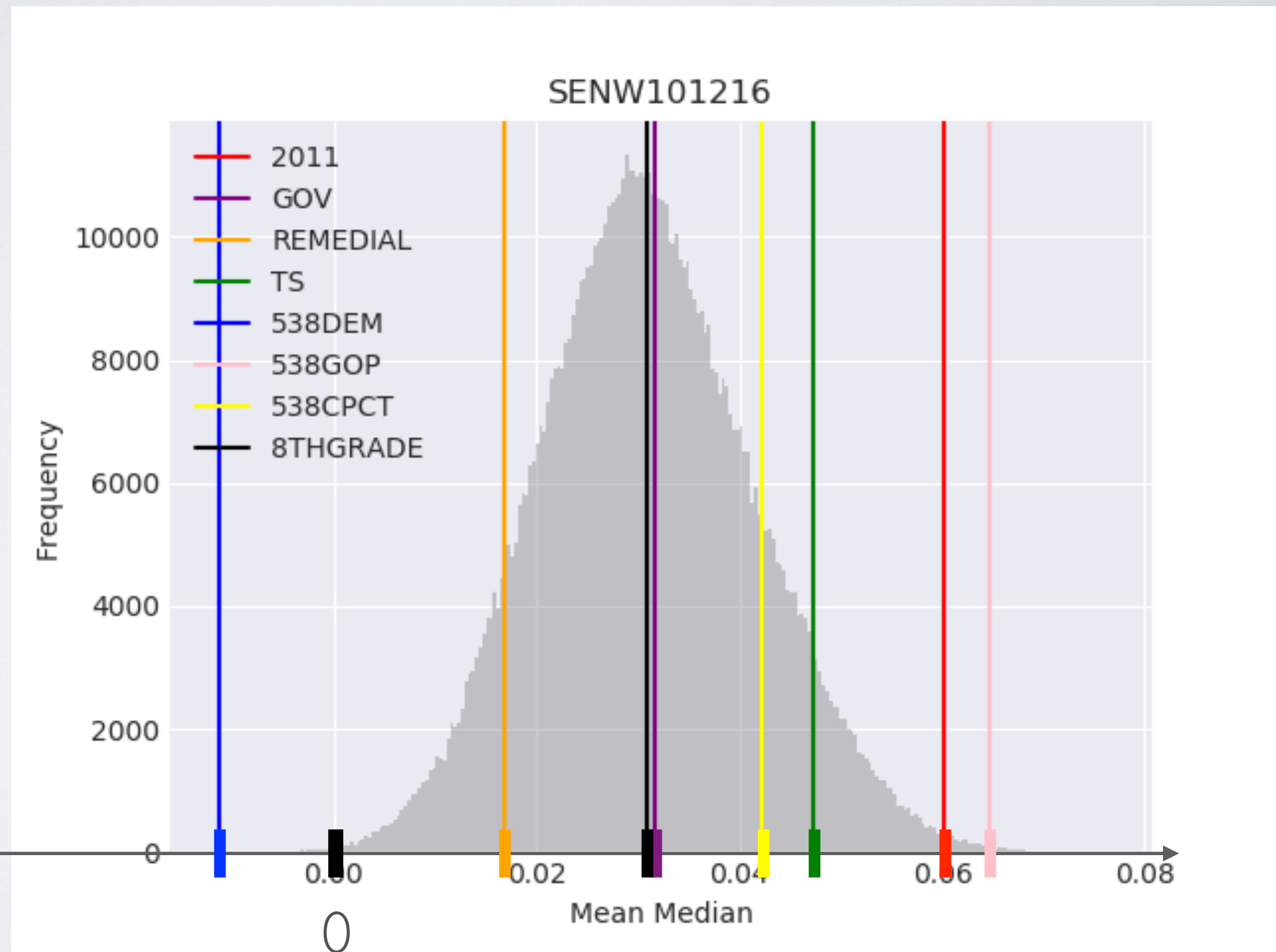


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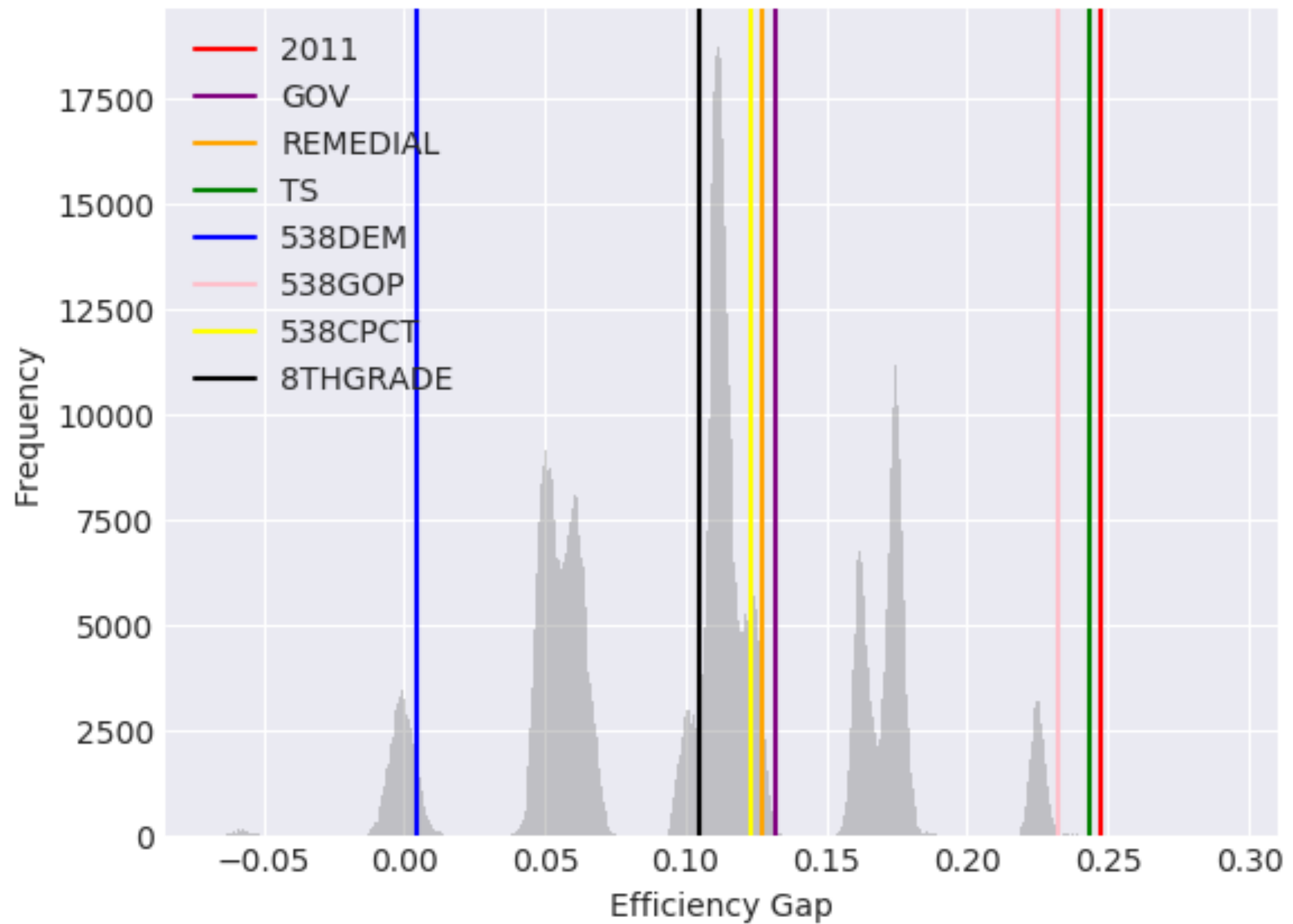


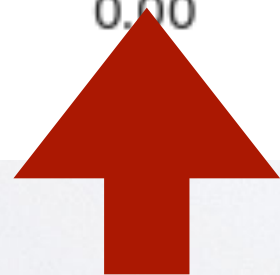
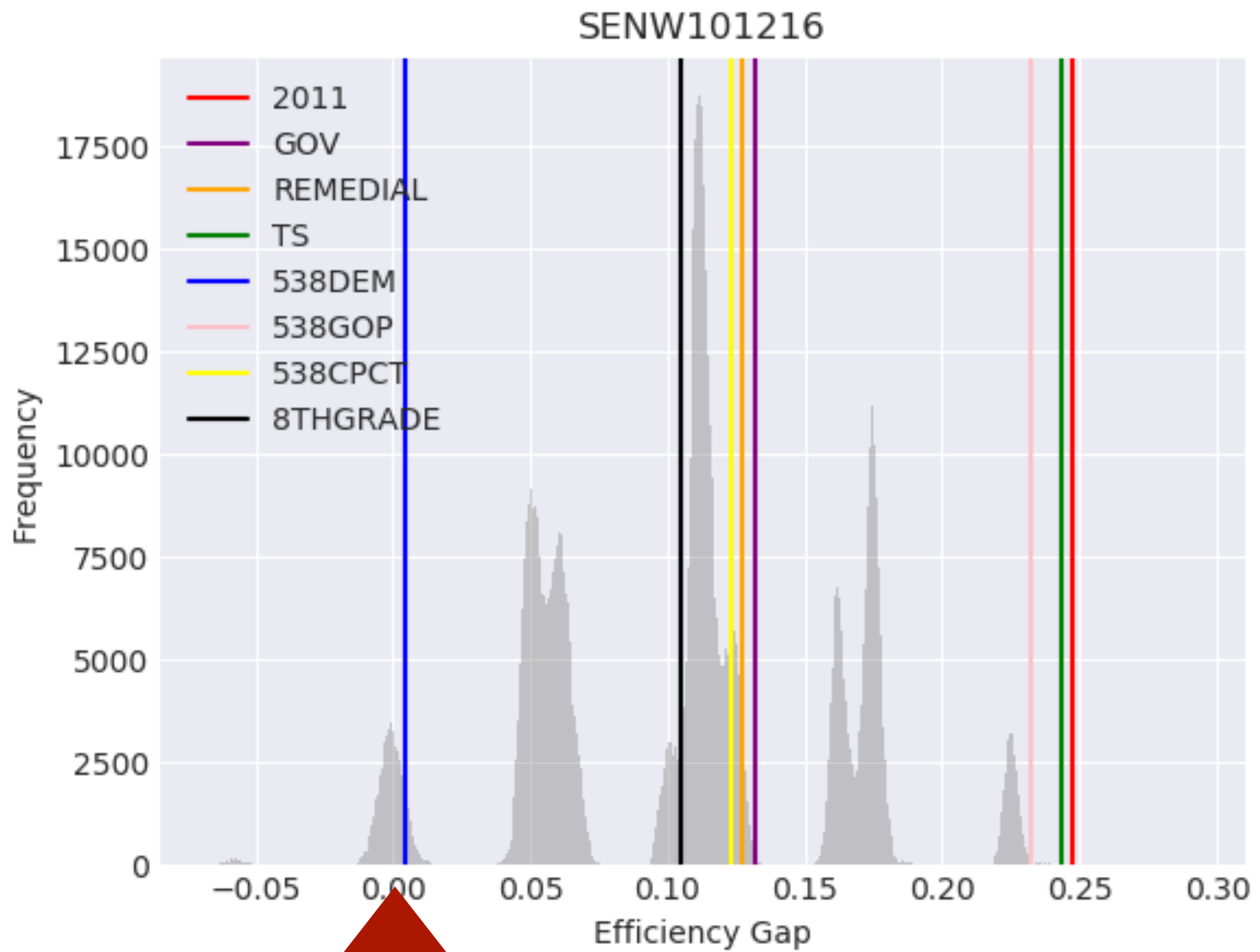
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SENW101216





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LEGAL STANDARD?

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- Some of us think so

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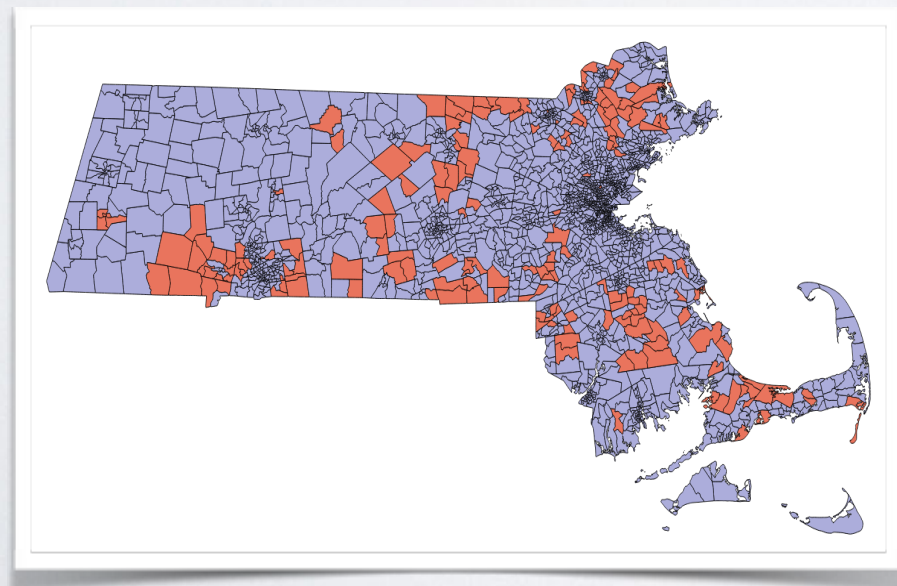
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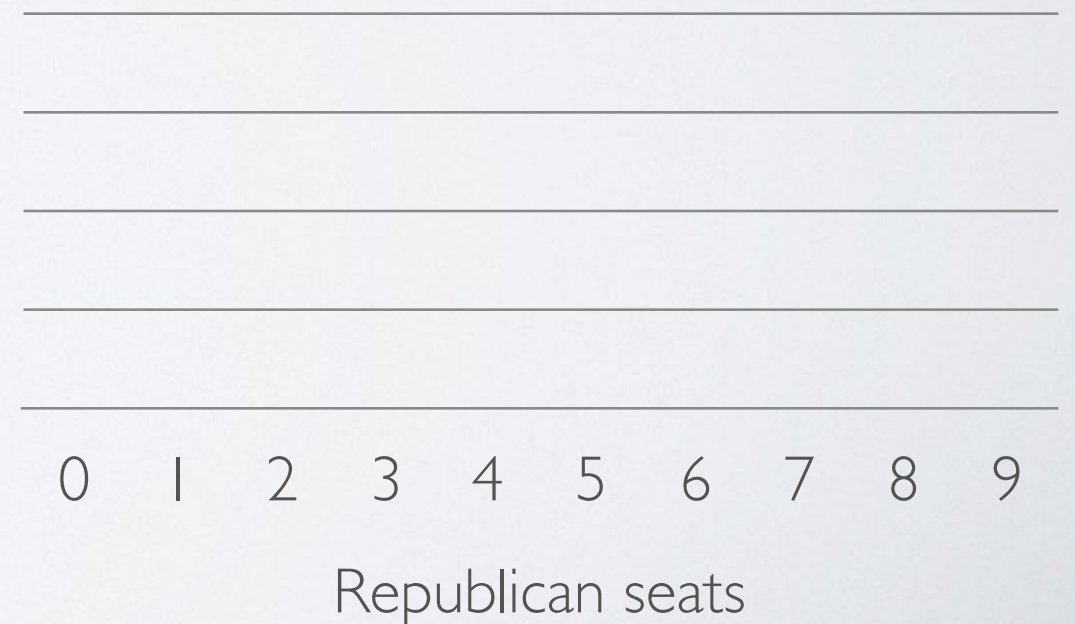
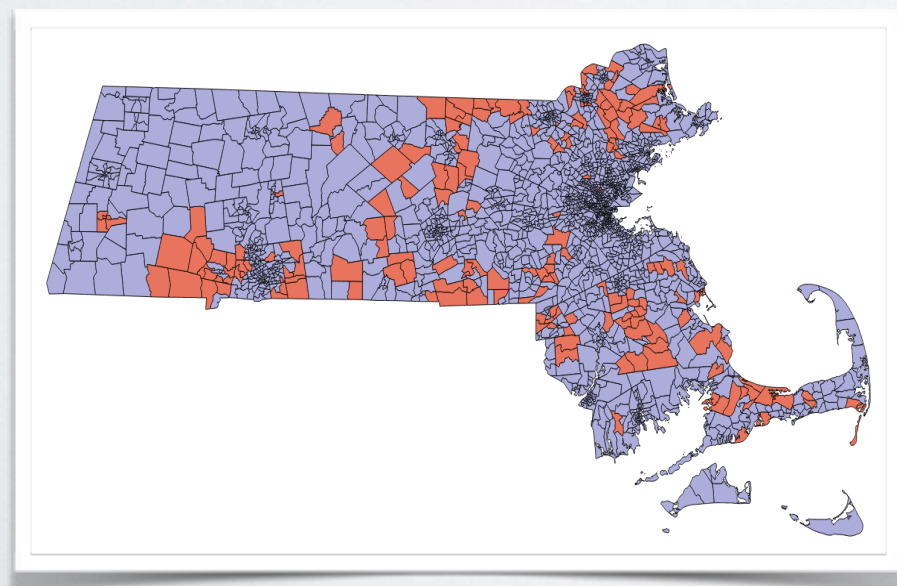
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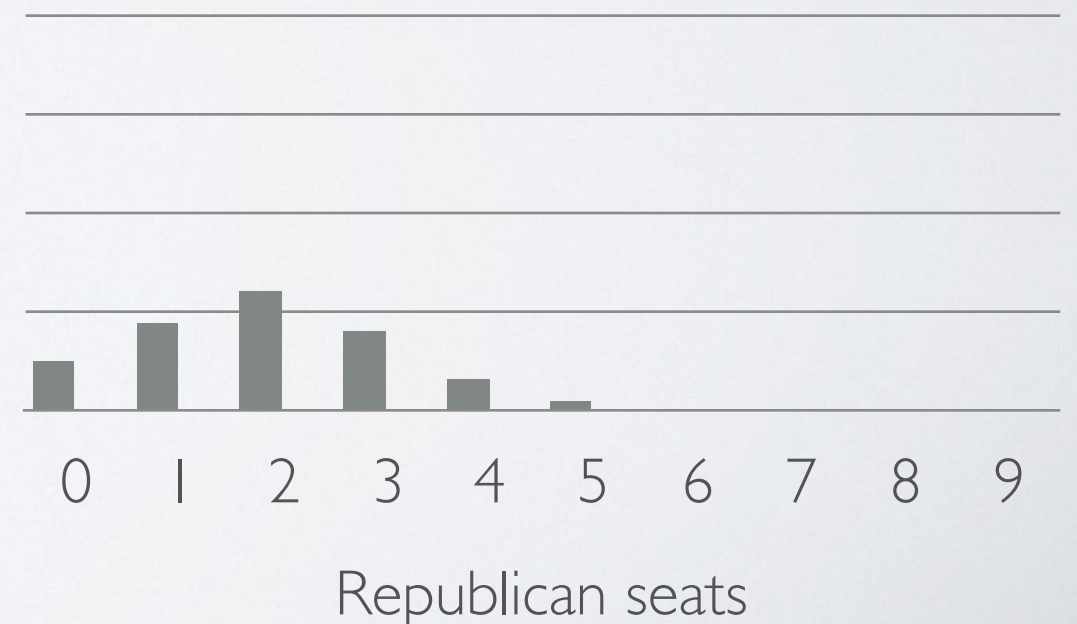
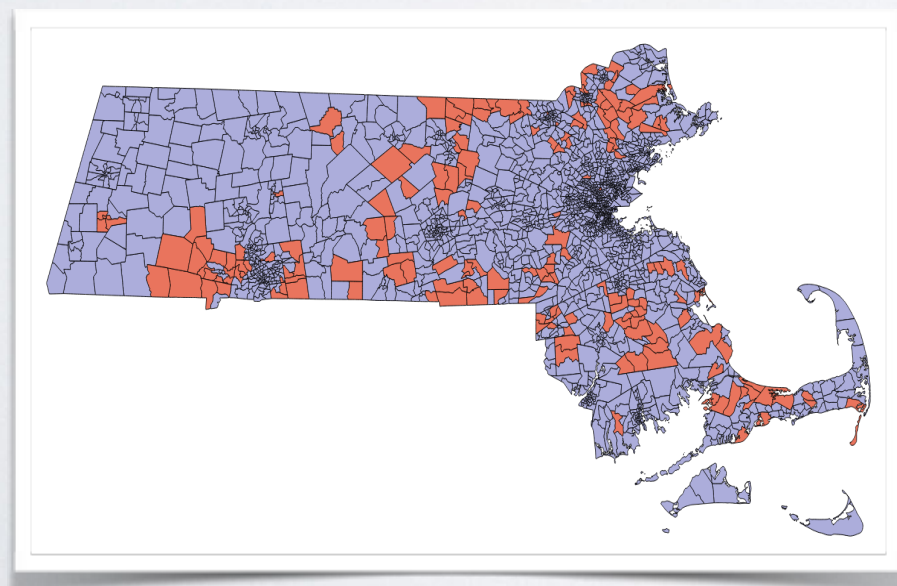
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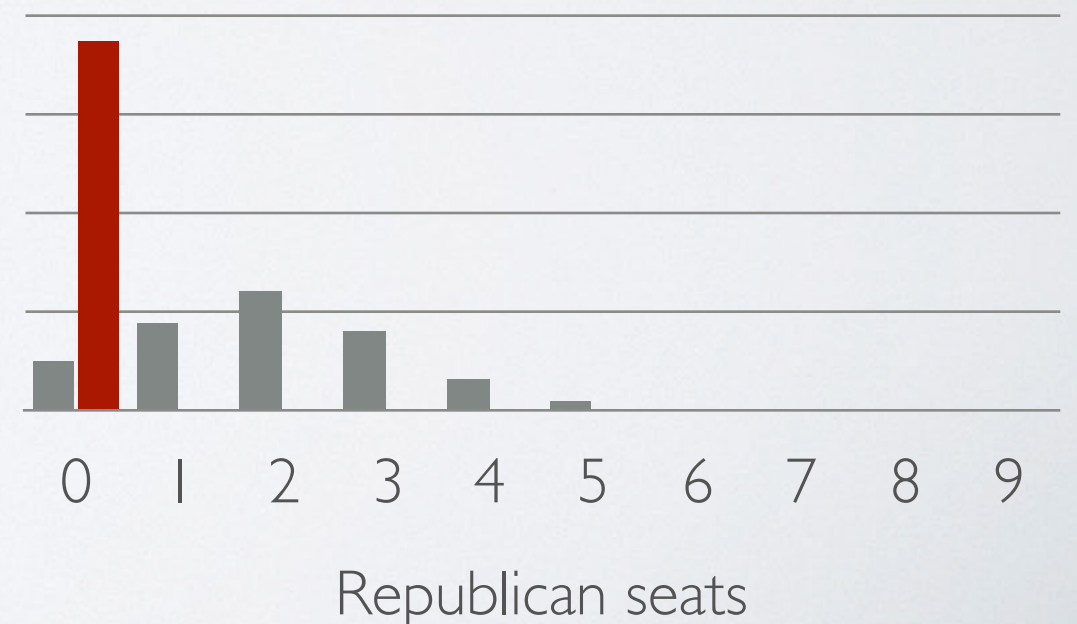
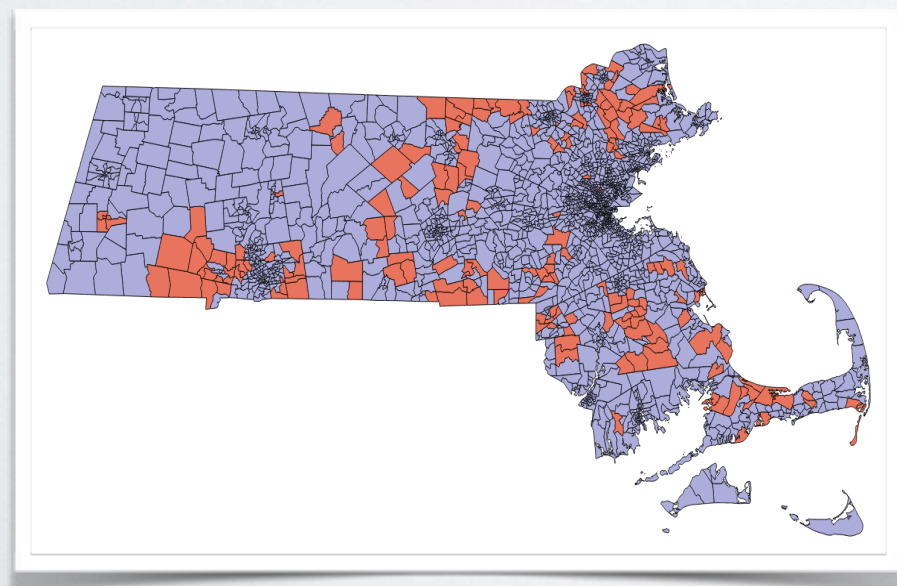
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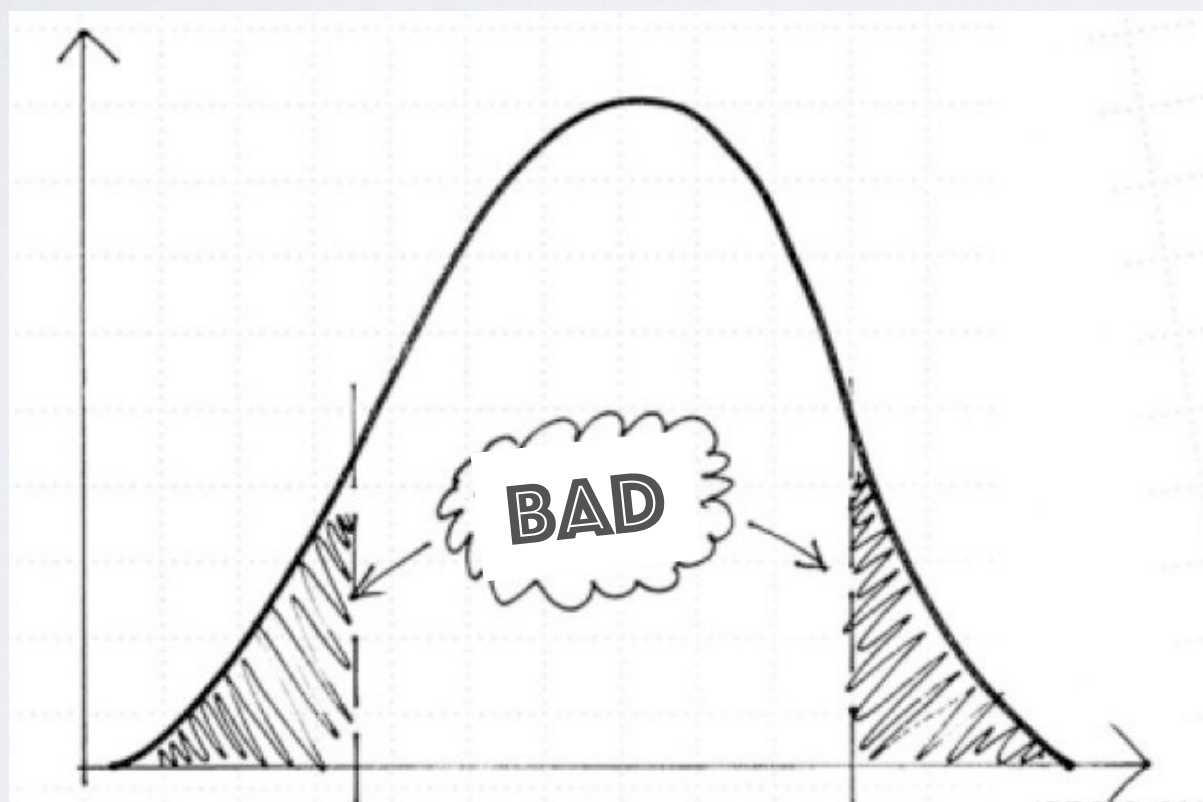


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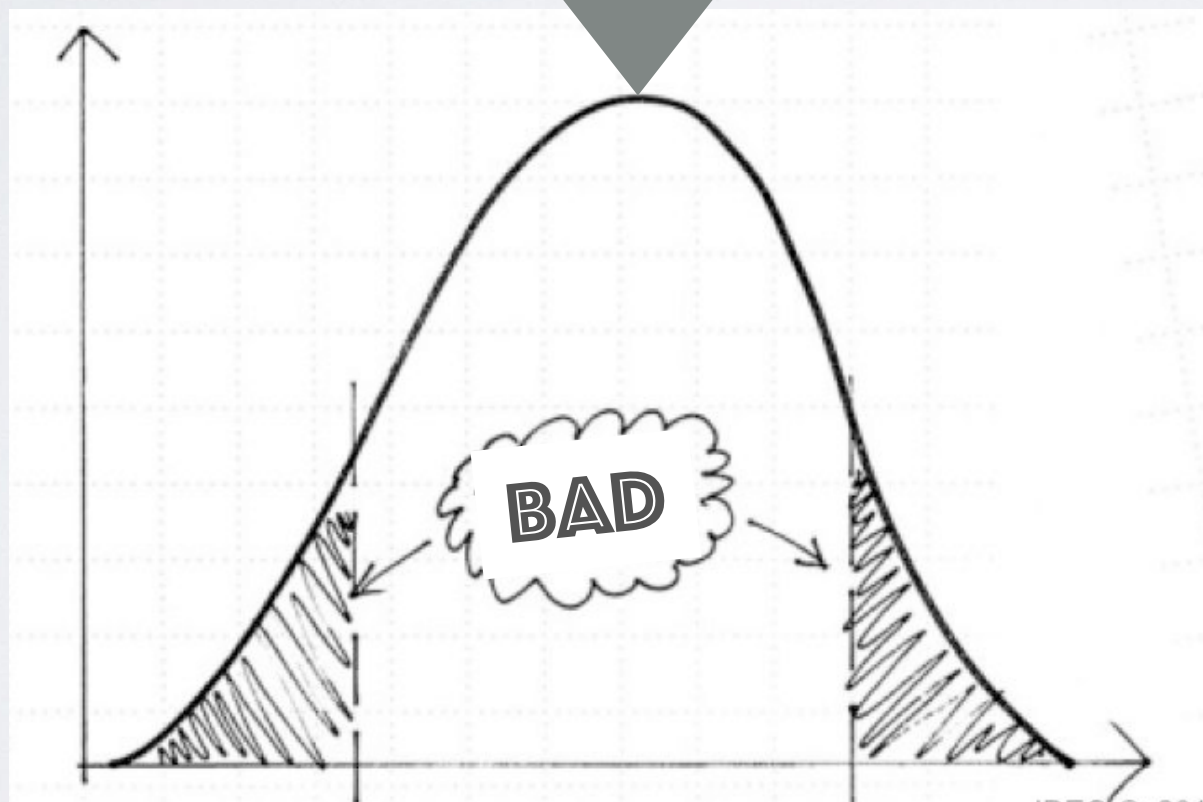
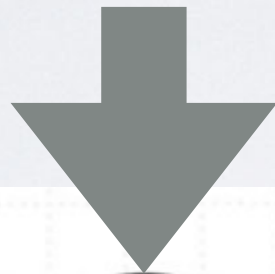
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IN THE END,
WHAT IS A FAIR MAP?



**NOT
NECESSARILY
AWESOME**



10 JUSTICE ALITO: Can I take you back to
11 questions that were asked before? If you -- if
12 you make a list of the so-called neutral
13 criteria -- compactness, contiguity, protecting
14 incumbents, if that's really neutral,
15 respecting certain natural features of the
16 geography -- and you have a computer program
17 that includes all of those and weights them
18 all, and let's assume all that is neutral, and
19 at the end, what you get is a large number of
20 maps that satisfy all those criteria.

9 JUSTICE ALITO: No, no, but can you
10 just answer that -- that question, because it's
11 a real puzzle to me. So you've got -- let's
12 say you've got 100 maps or you might even have
13 25. I think you probably have thousands. So
14 you have all of these maps, and you have to
15 choose among them. The legislature chooses
16 among them.

17 And you've already programmed in all
18 of the so-called neutral criteria. How do you
19 -- how does the legislature go about choosing
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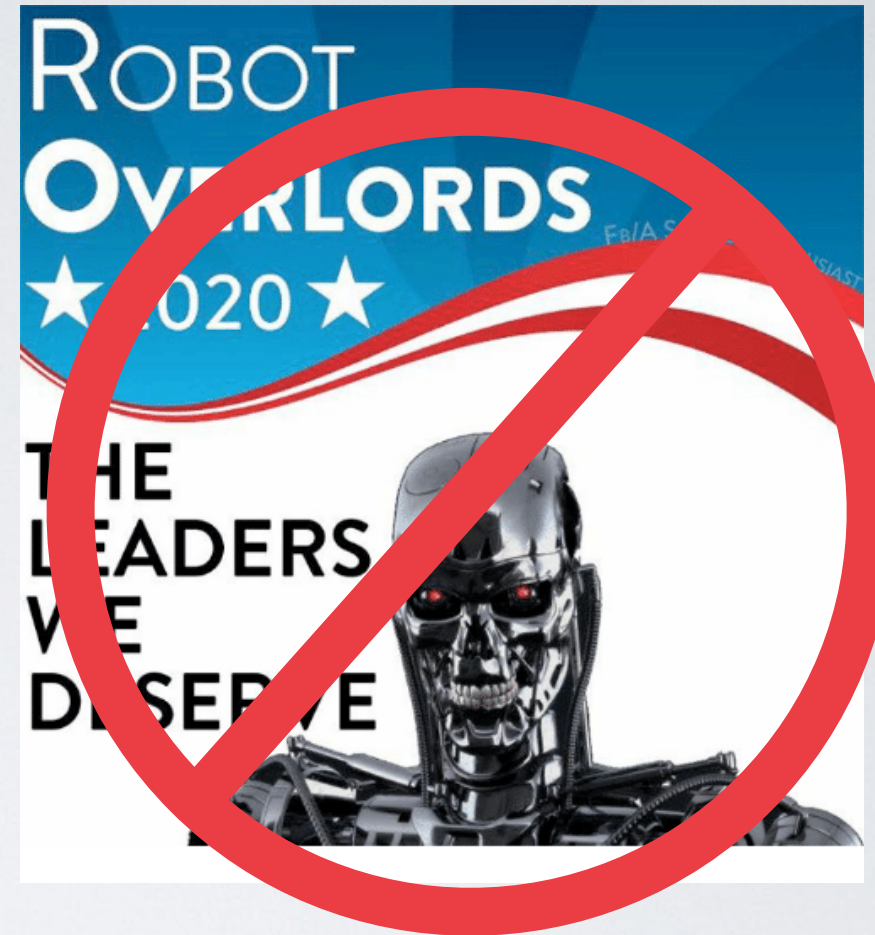
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17 that includes all of those and weights them
18 all, and let's assume all that is neutral, and
19 at the end, what you get is a large number of
20 maps that satisfy all those criteria.

9 JUSTICE ALITO: No, no, but can you
10 just answer that -- that question, because it's
11 a real puzzle to me. So you've got -- let's
12 say you've got 100 maps or you might even have
13 25. I think you probably have thousands. So
14 you have all of these maps, and you have to
15 choose among them. The legislature chooses
16 among them.

17 And you've already programmed in all
18 of the so-called neutral criteria. How do you
19 -- how does the legislature go about choosing
20 among those maps? Would anything other than
21 just random choice be sufficient -- be
22 satisfactory?

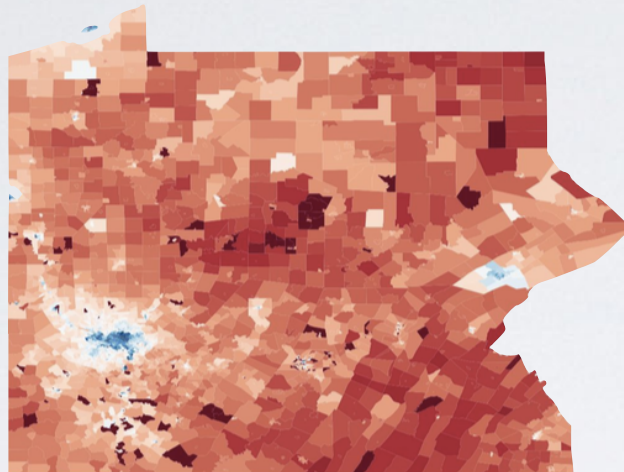


ON THE GROUND

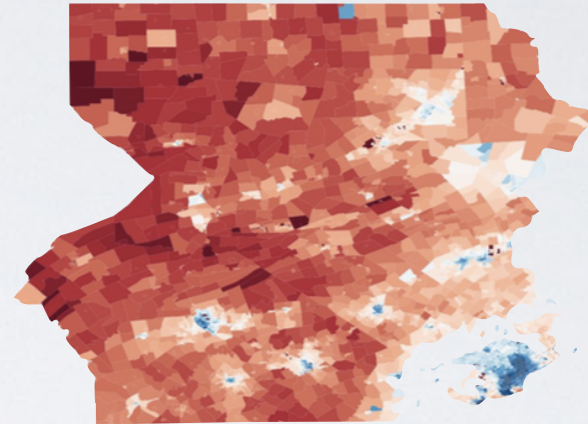
Pennsylvania

Question: political geography

“Westsylvania”
41% Dem in Pres16

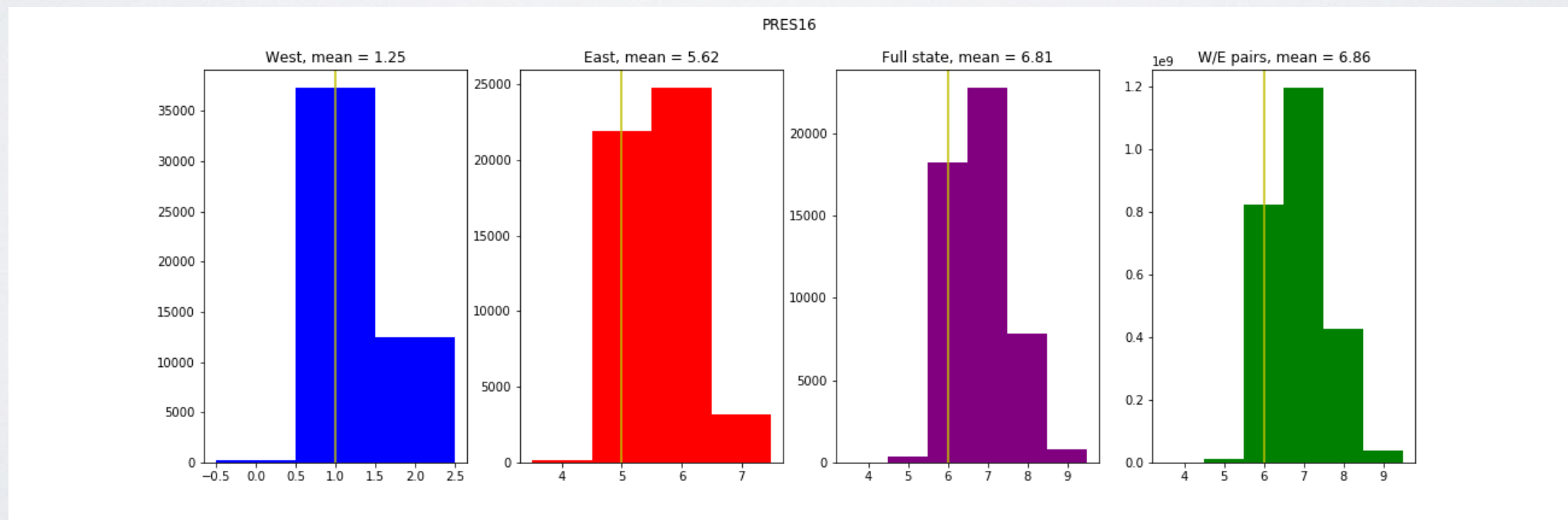


“Eastsylvania”
53% Dem in Pres16



neutral draw: 21% W seats 47% E seats

38% seats overall



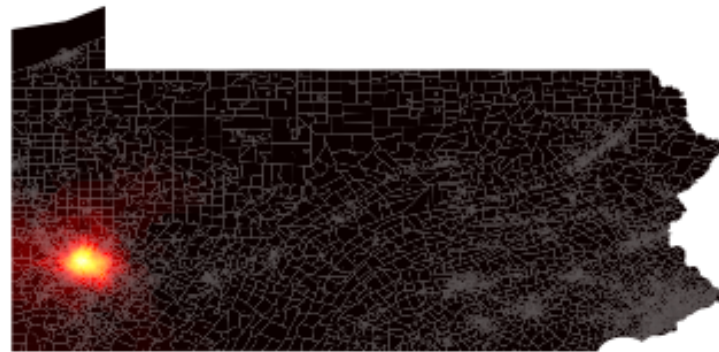
Pennsylvania

Question: scale effects

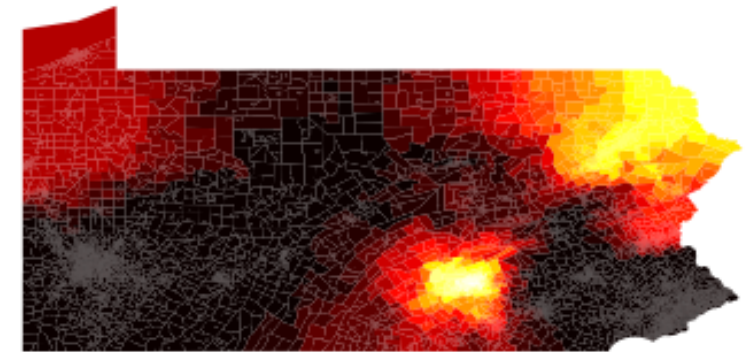
class #1



class #2



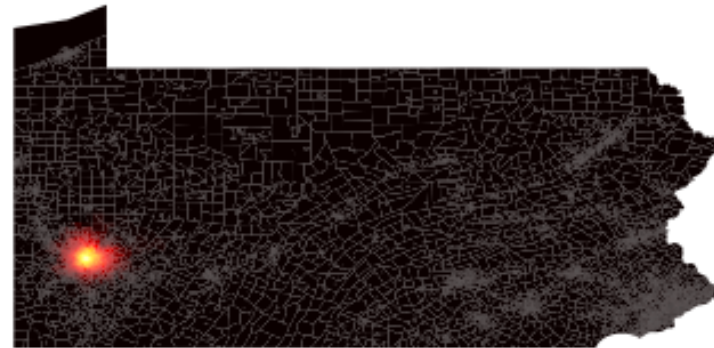
class #3



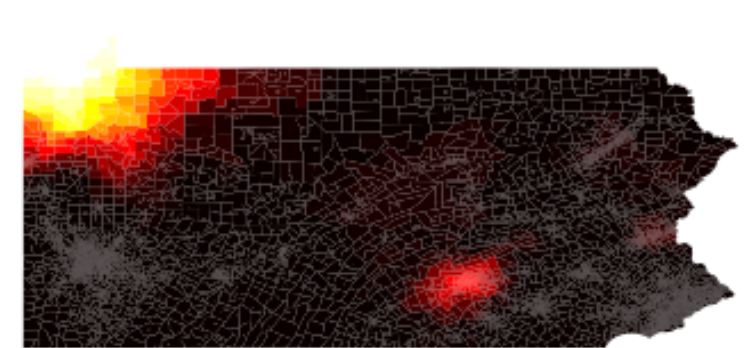
class #1



class #2



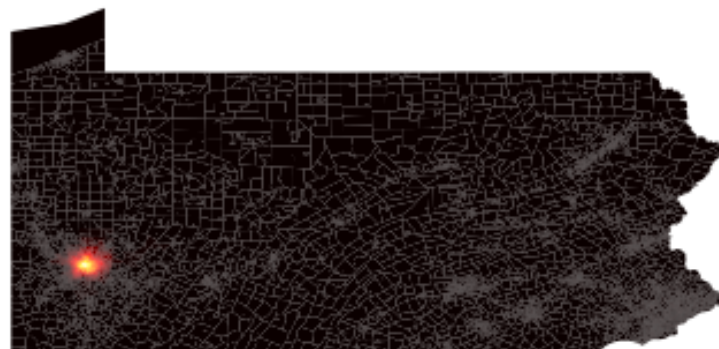
class #3



class #1



class #2

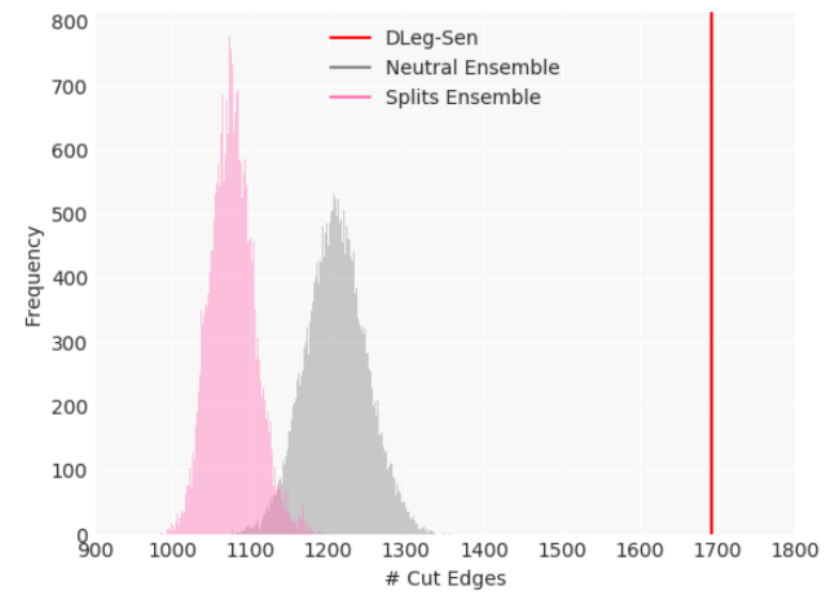
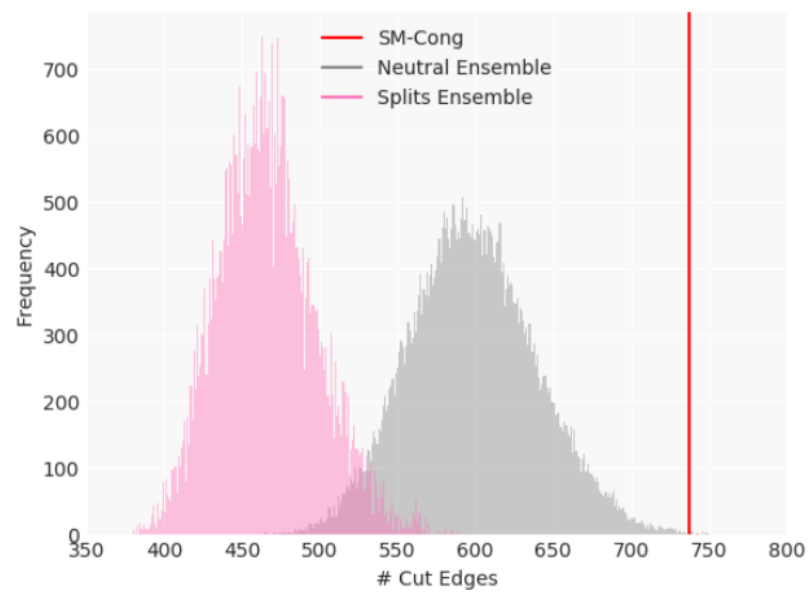


class #3



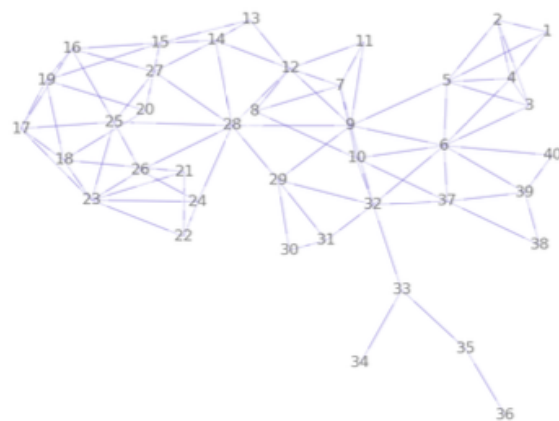
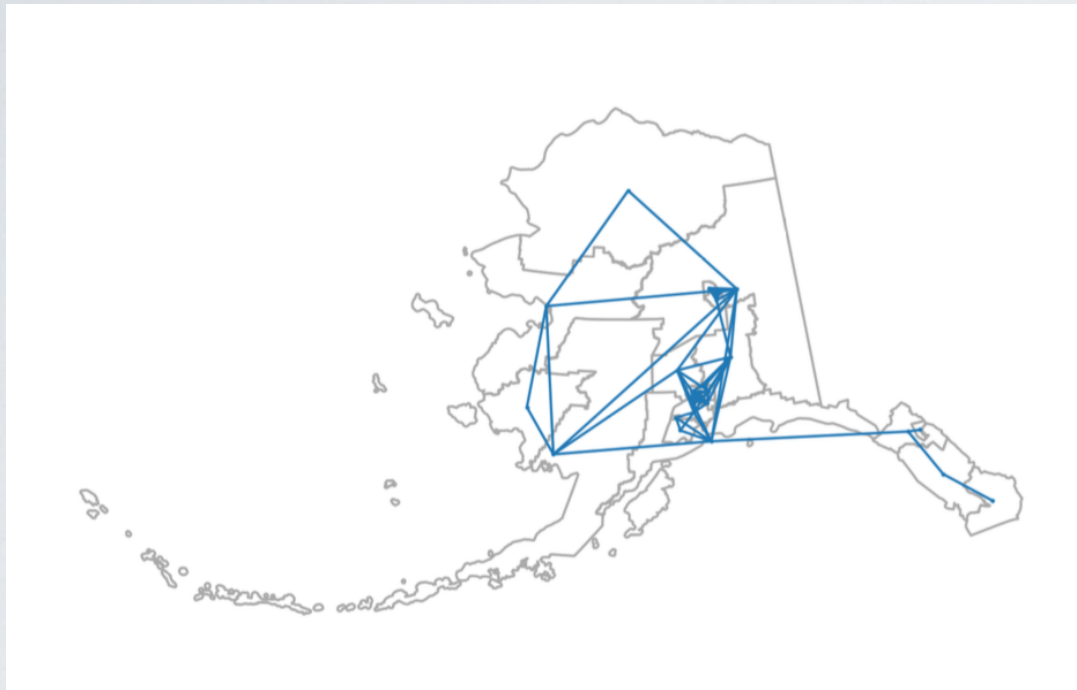
Virginia

Question: criteria interactions, VRA

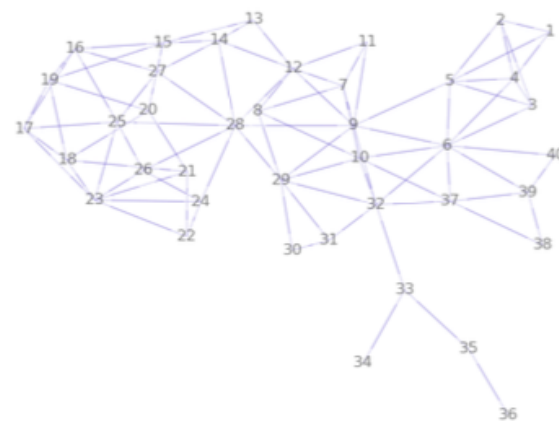


Alaska

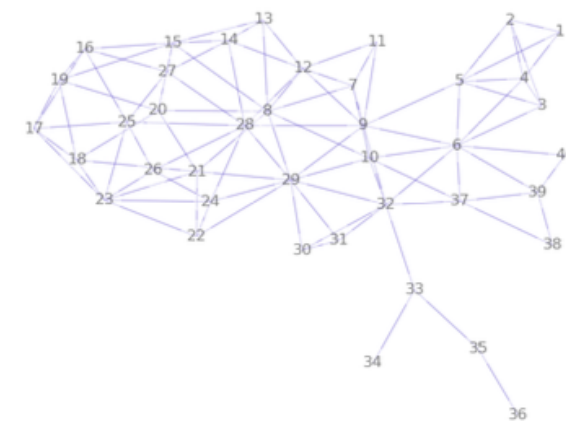
Question: nesting rules vs. partisan balance



Tight
(89 edges)



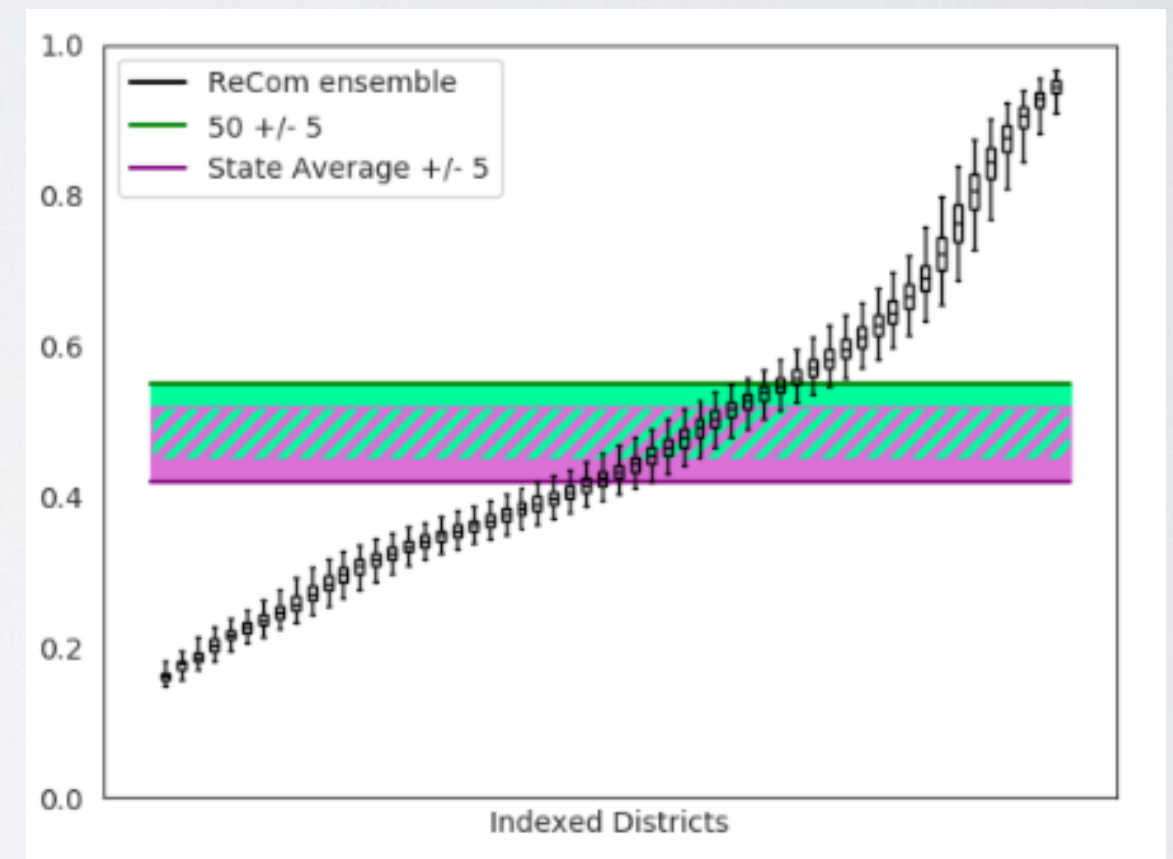
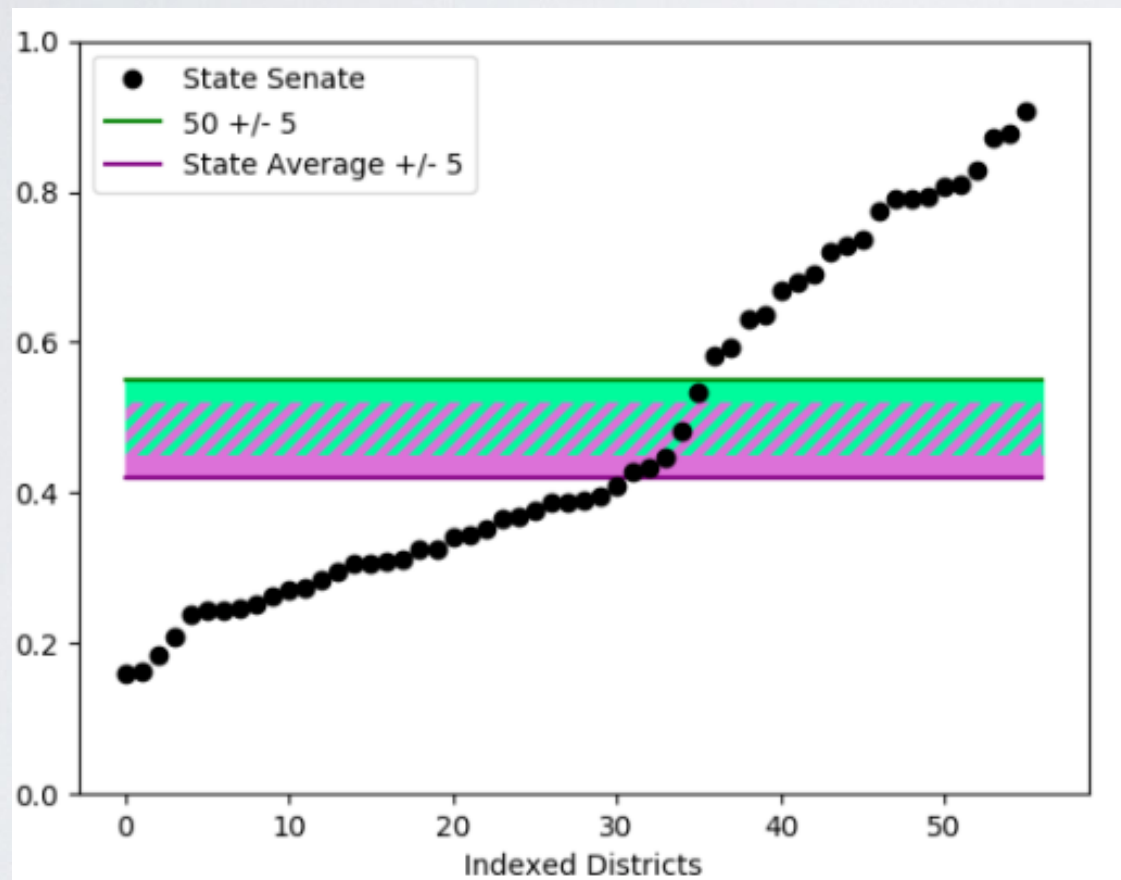
Restricted
(92 edges)



Permissive
(100 edges)

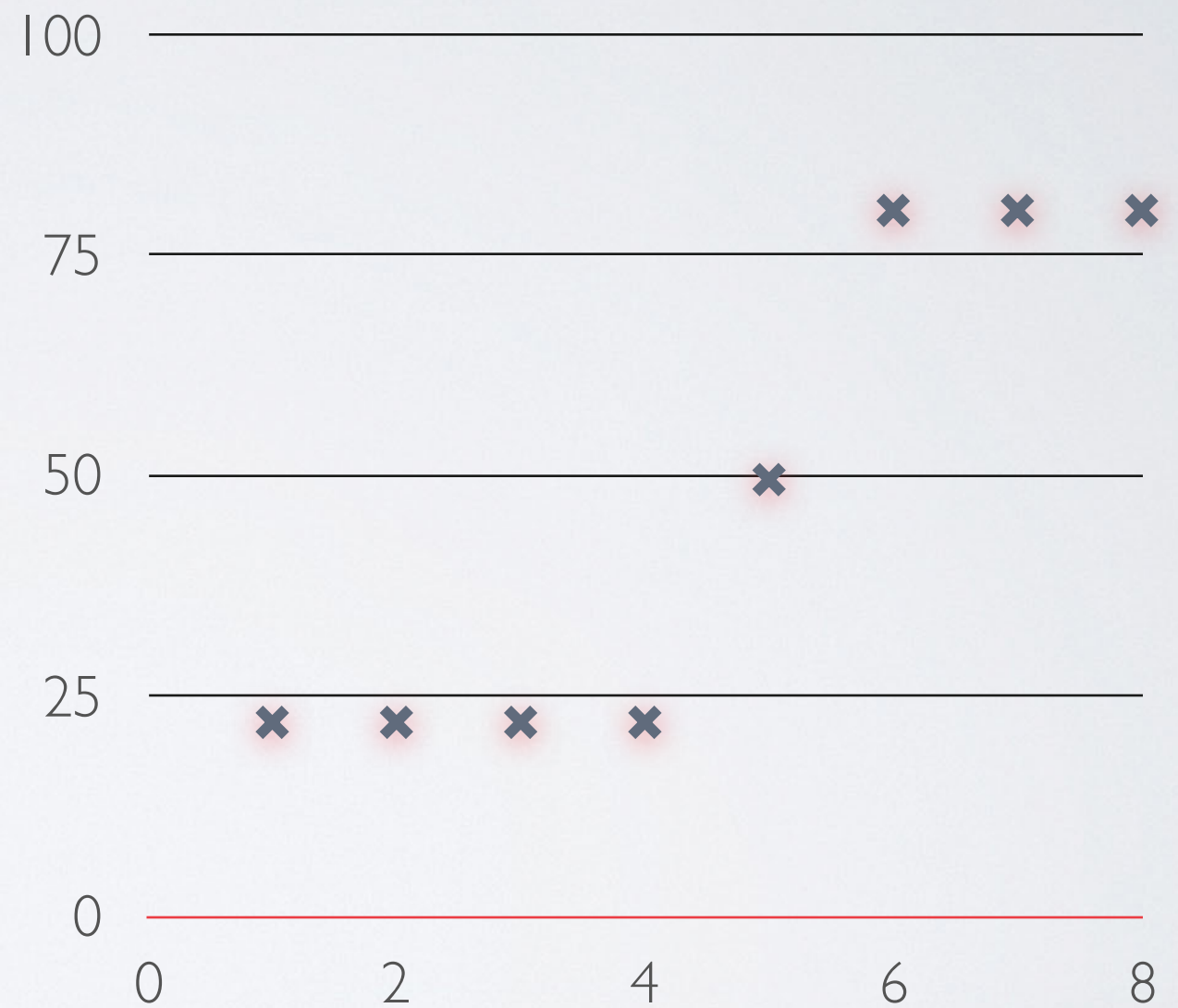
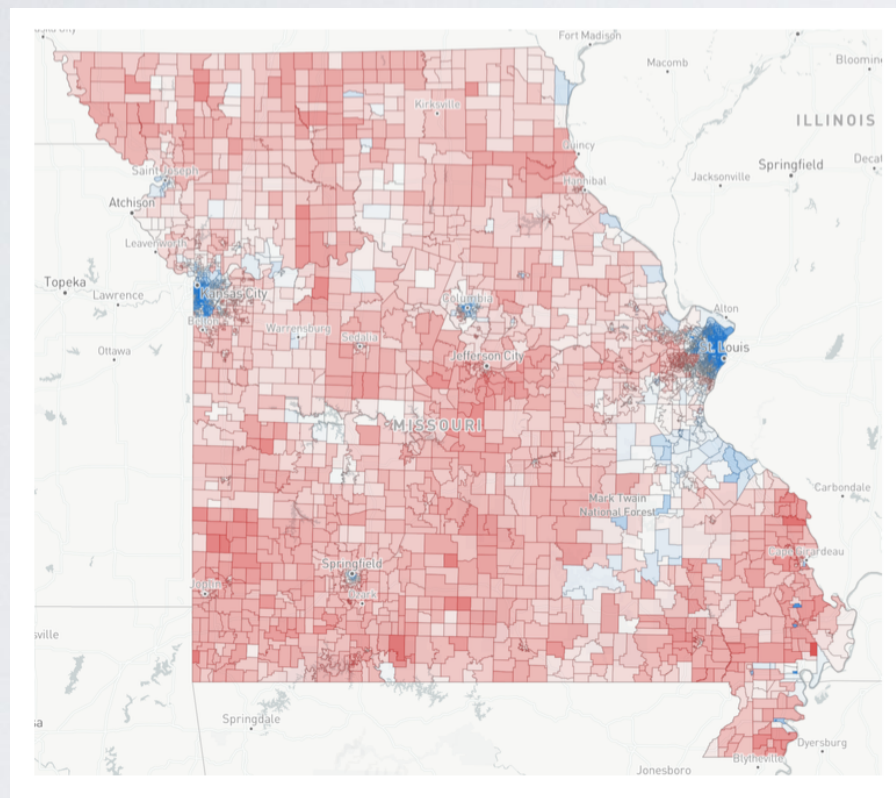
Georgia

Question: competitiveness



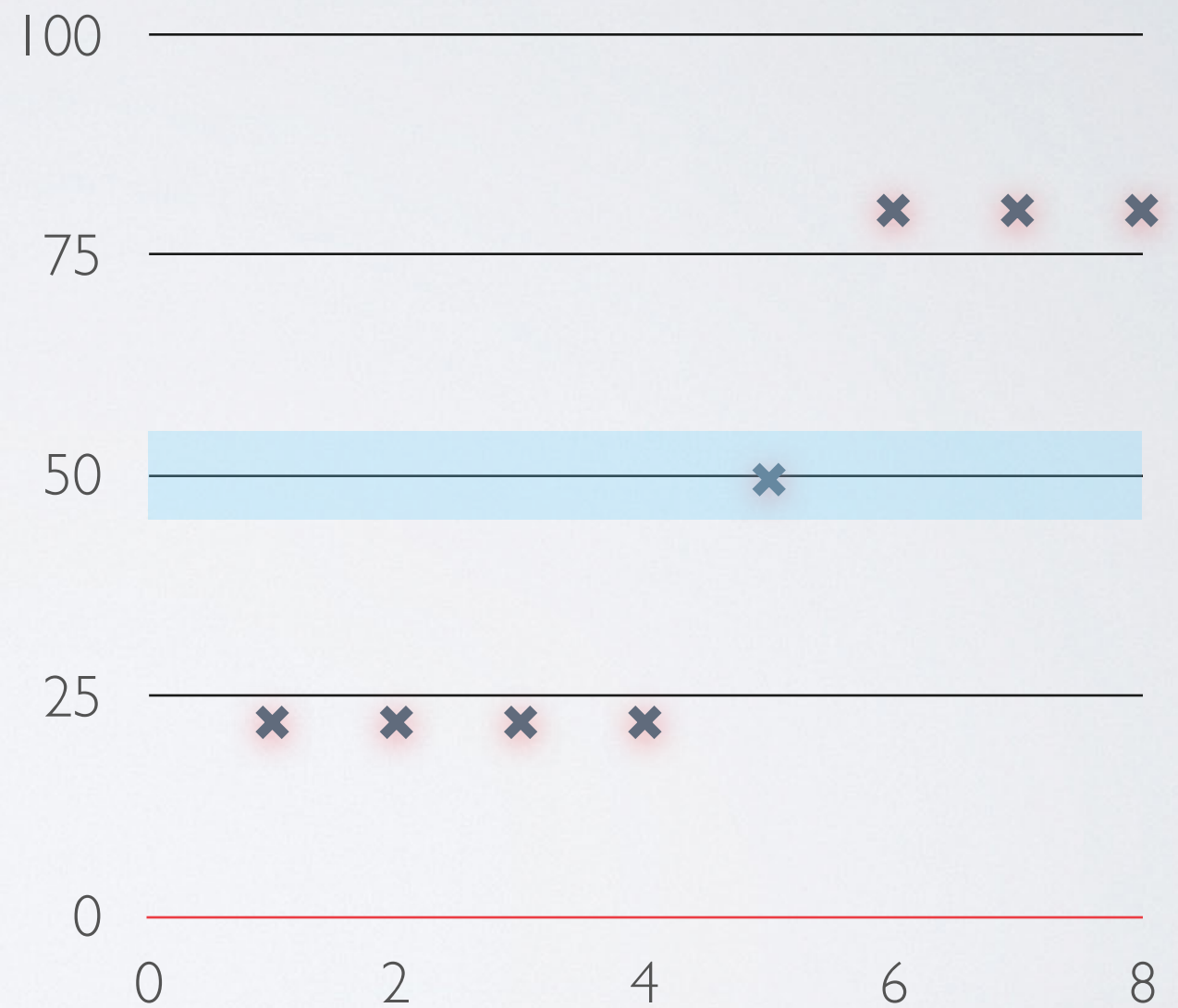
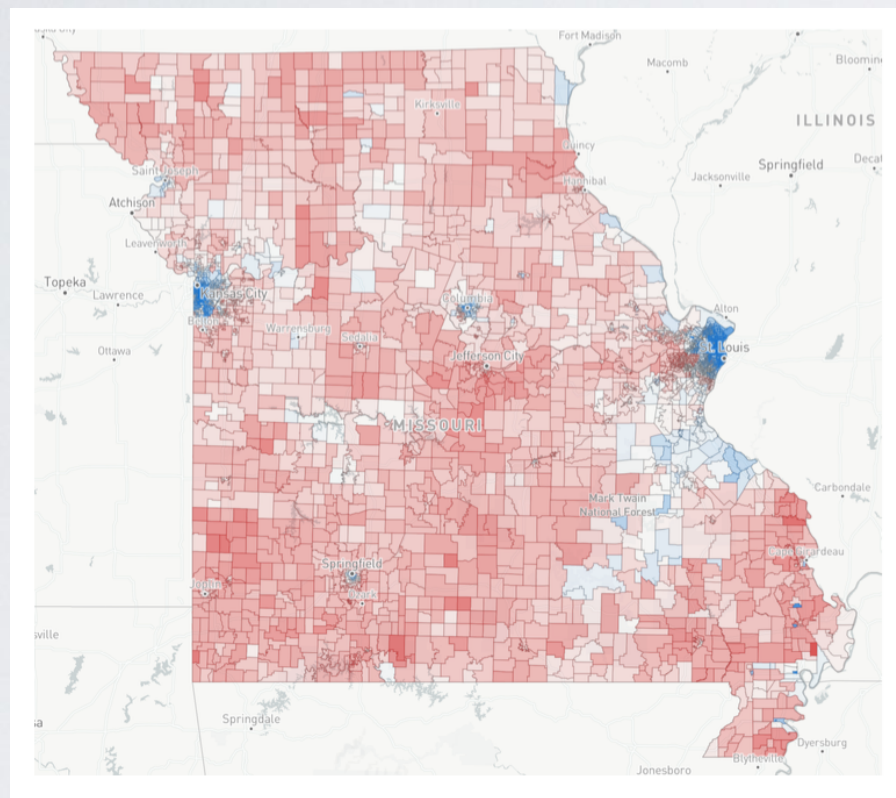
Missouri

Question: competitiveness



Missouri

Question: competitiveness

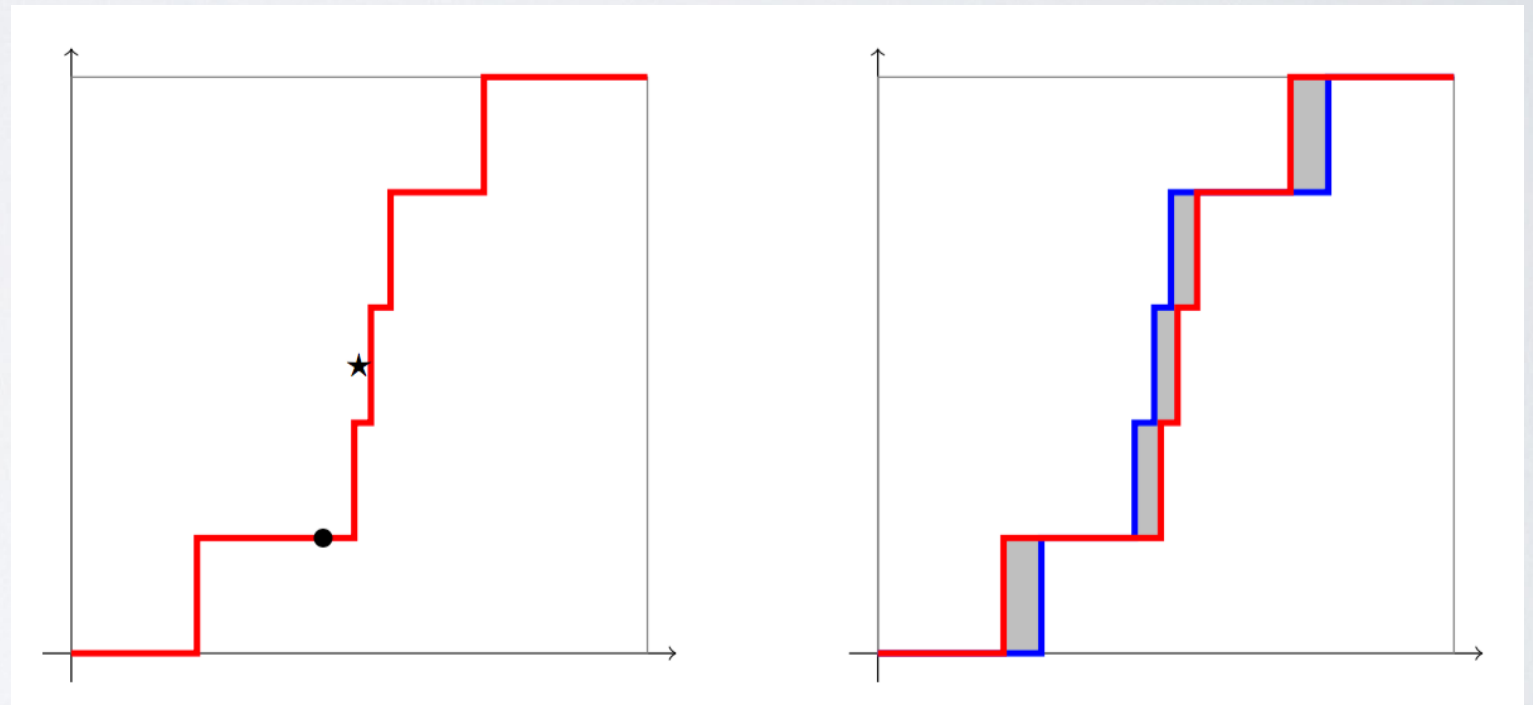


Utah

Question: partisan symmetry

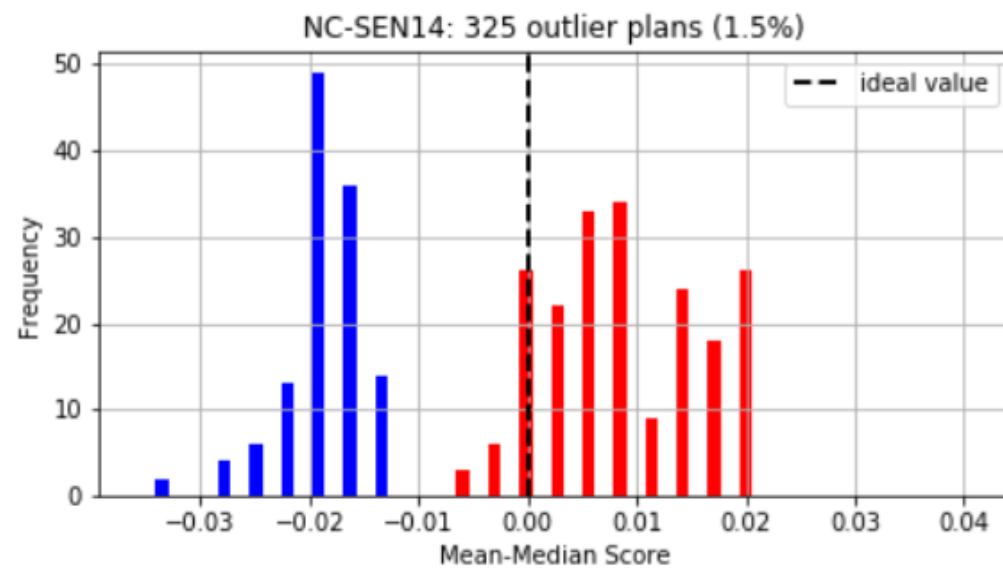
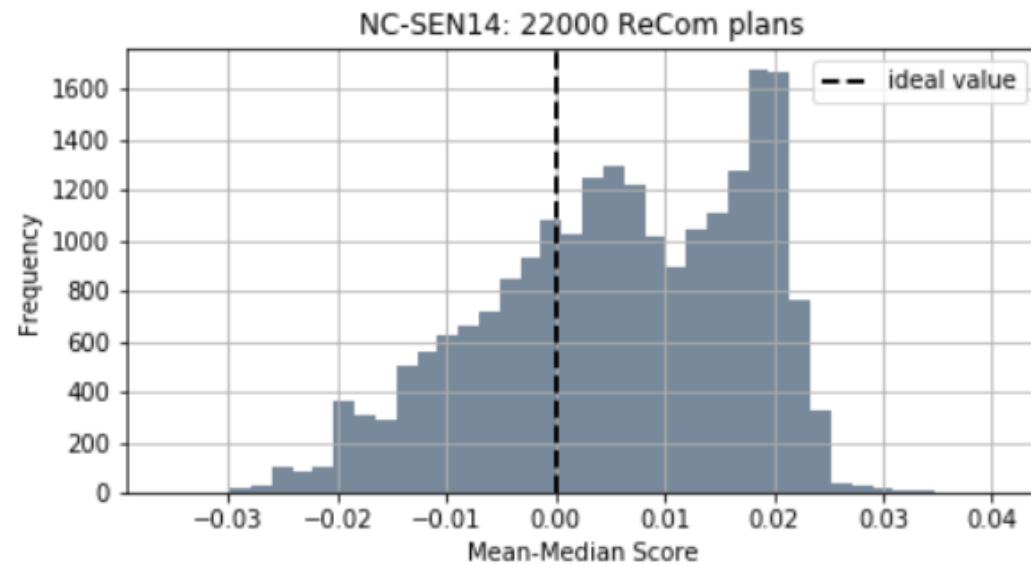
Partisan symmetry generalities:
as you swing the vote, you
should generate a curve that is
symmetric about (50,50)

Example: Oregon 2016



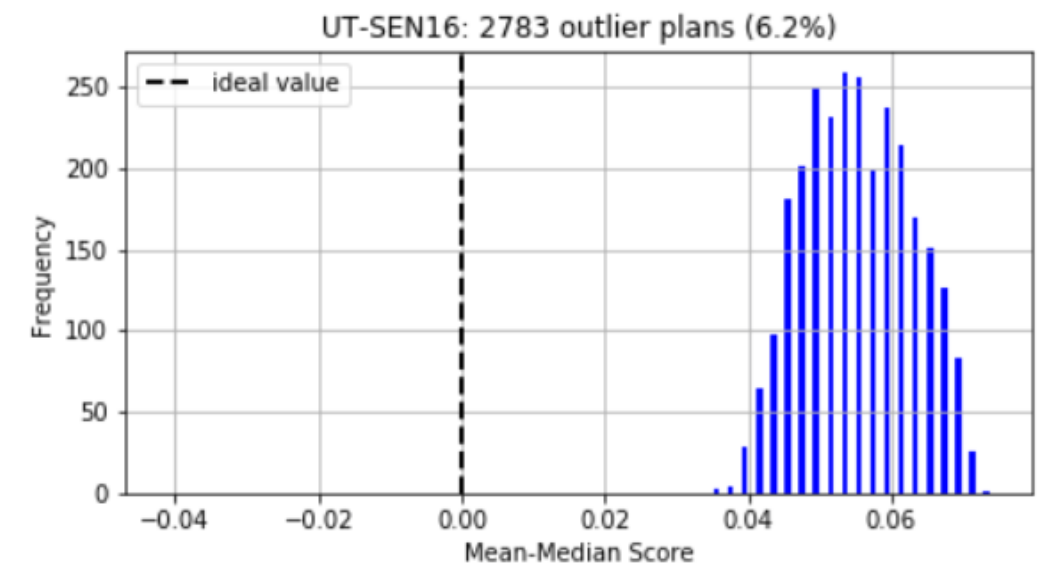
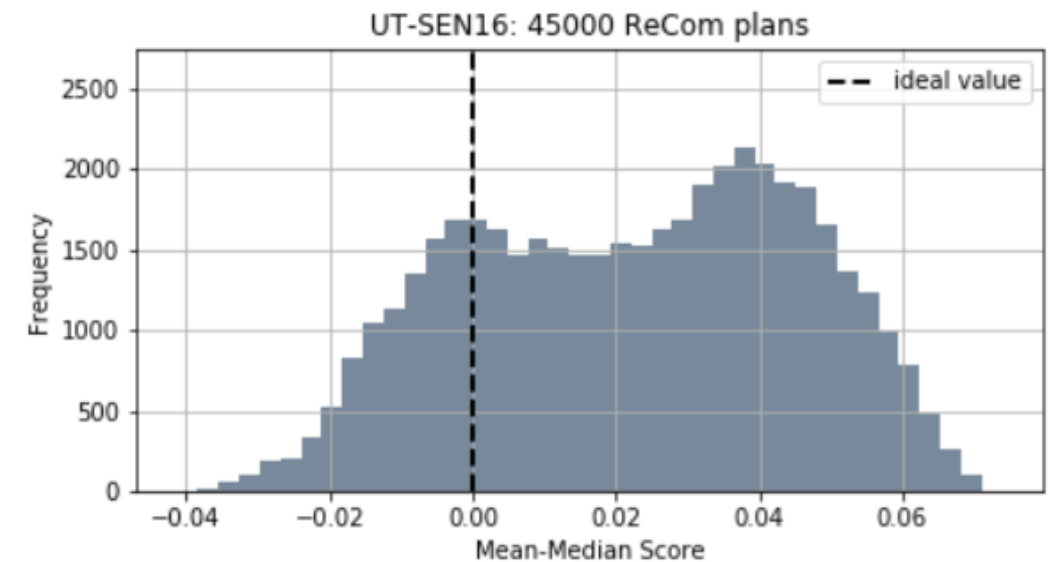
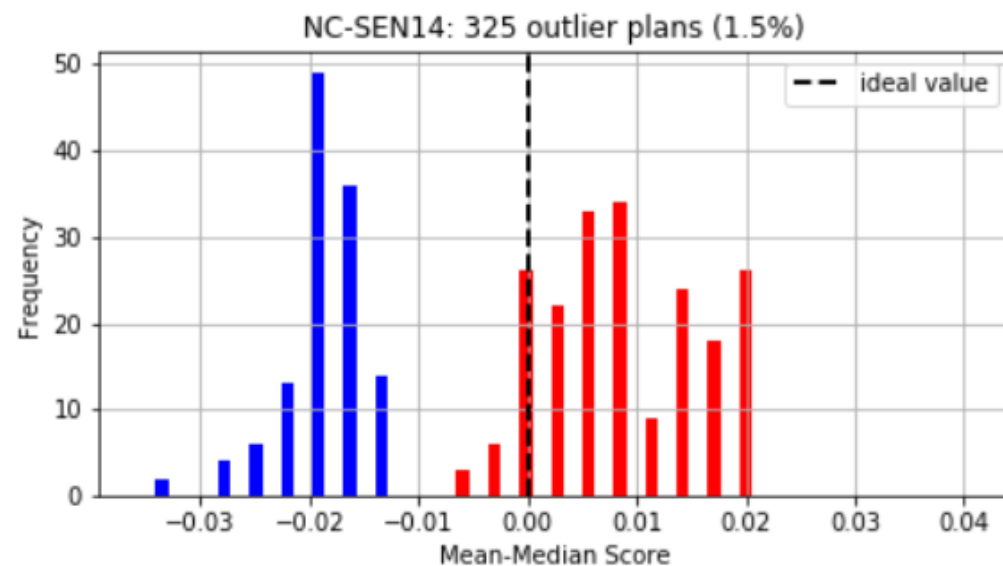
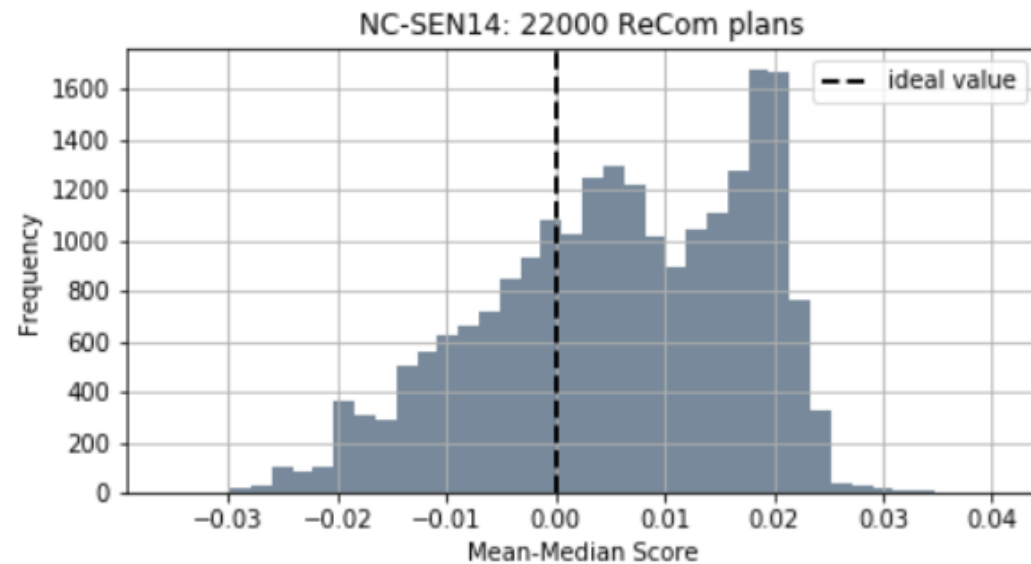
North Carolina, Utah

Question: partisan symmetry



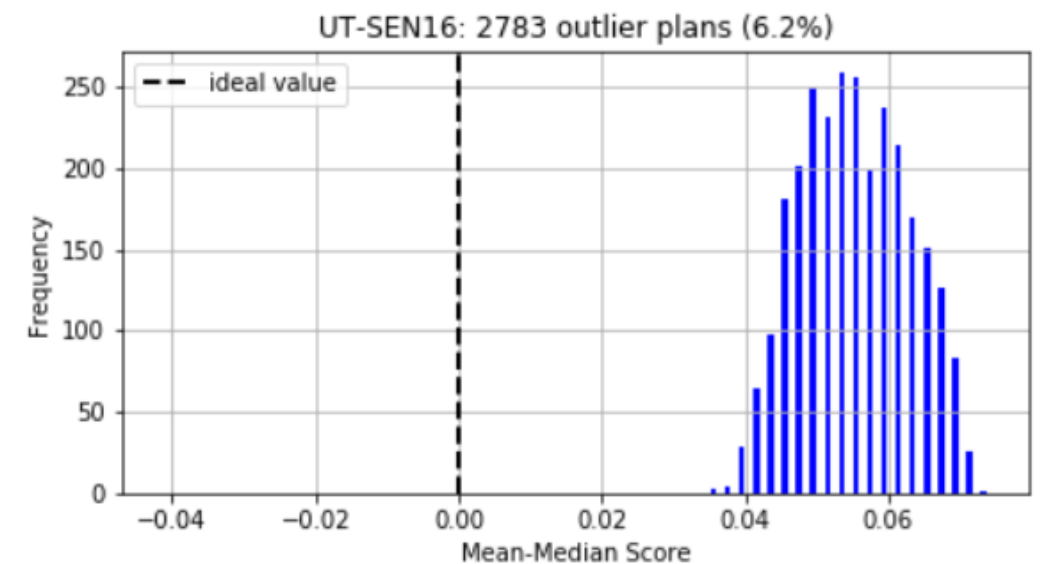
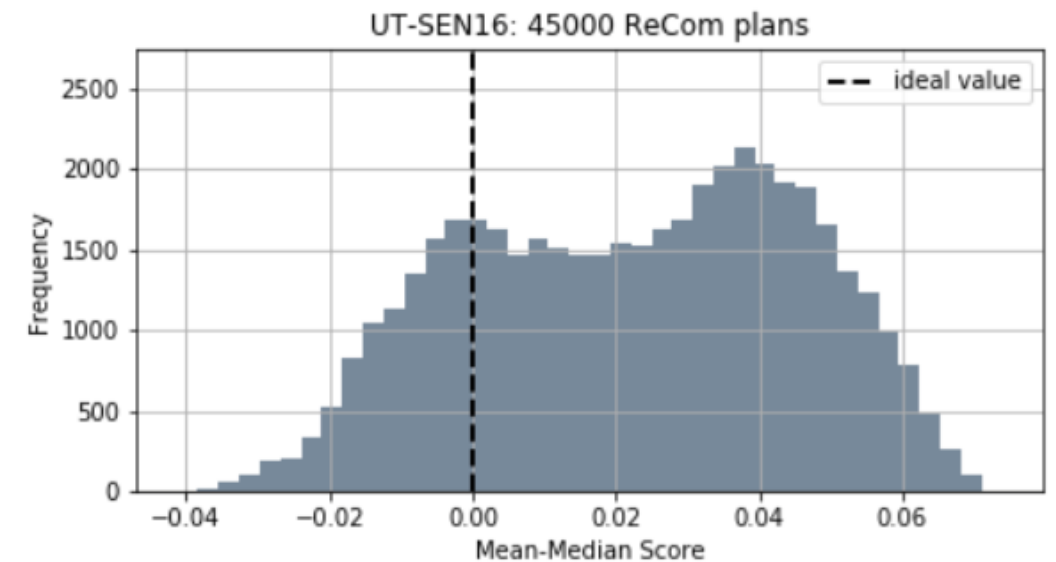
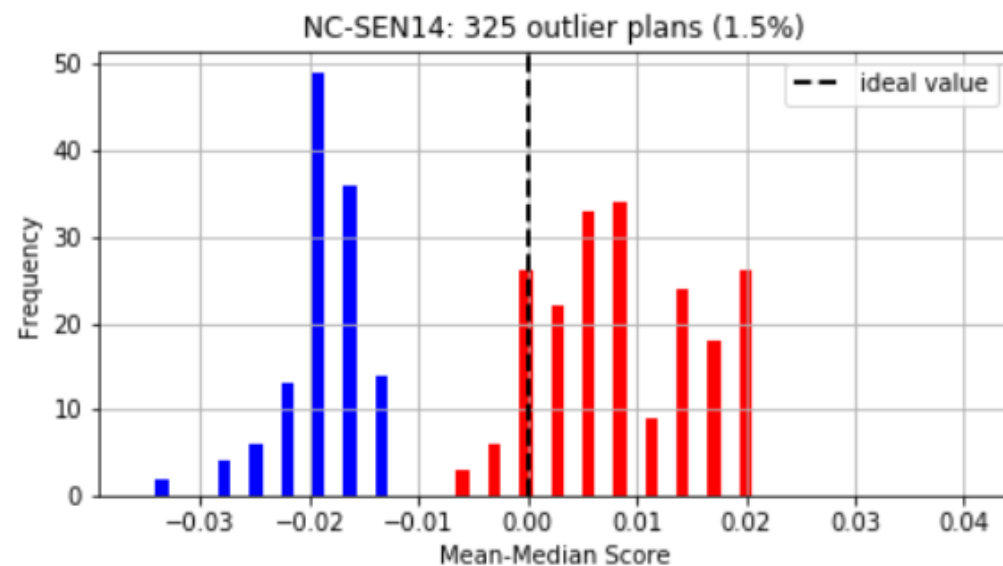
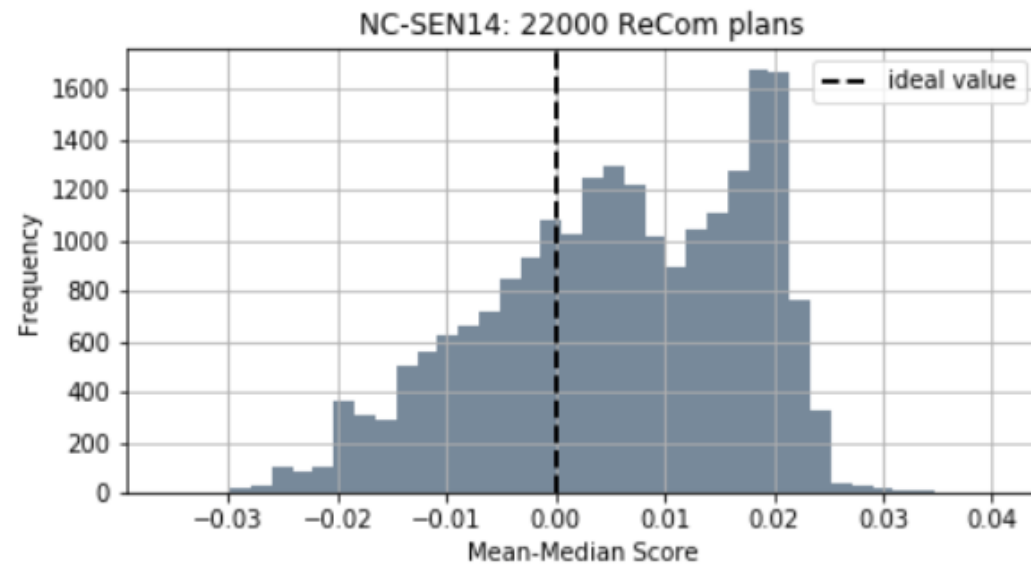
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Question: partisan symmetry

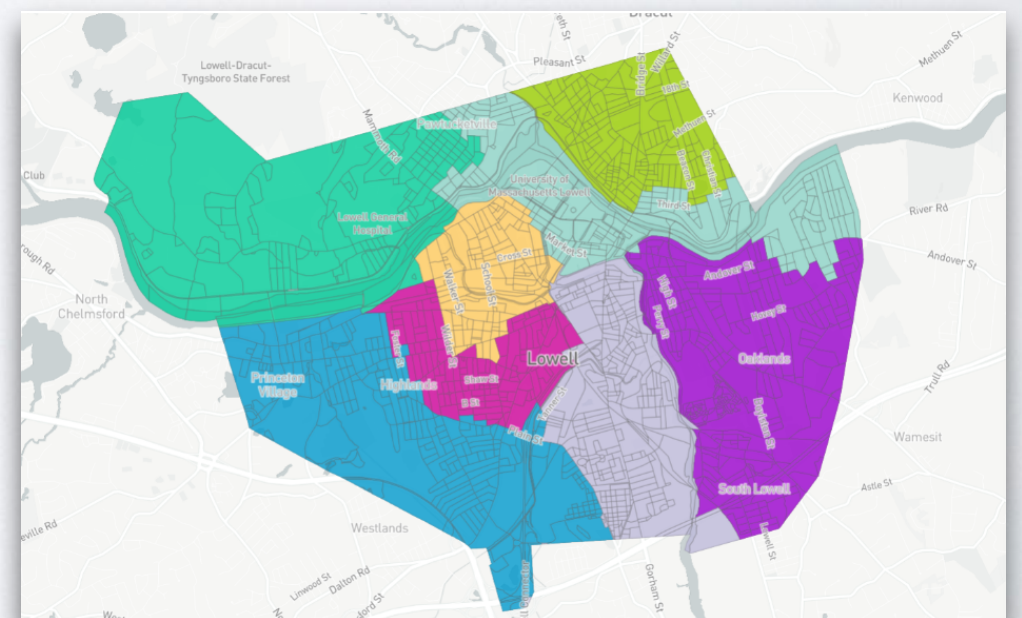


North Carolina, Utah

Question: partisan symmetry



Question: ranked choice or districts?



ASK ME ABOUT

- Coming to Tufts this summer for a 1-week think tank on best practices for redistricting: how *should* states, counties, cities set the rules?

mduchin@mggg.org



On Rucho:

tinyurl.com/normative-blog



mggg.org/amicus

mggg.org/chicago

mggg.org/competitiveness

mggg.org/VA-criteria

mggg.org/massachusetts

On Rucho:

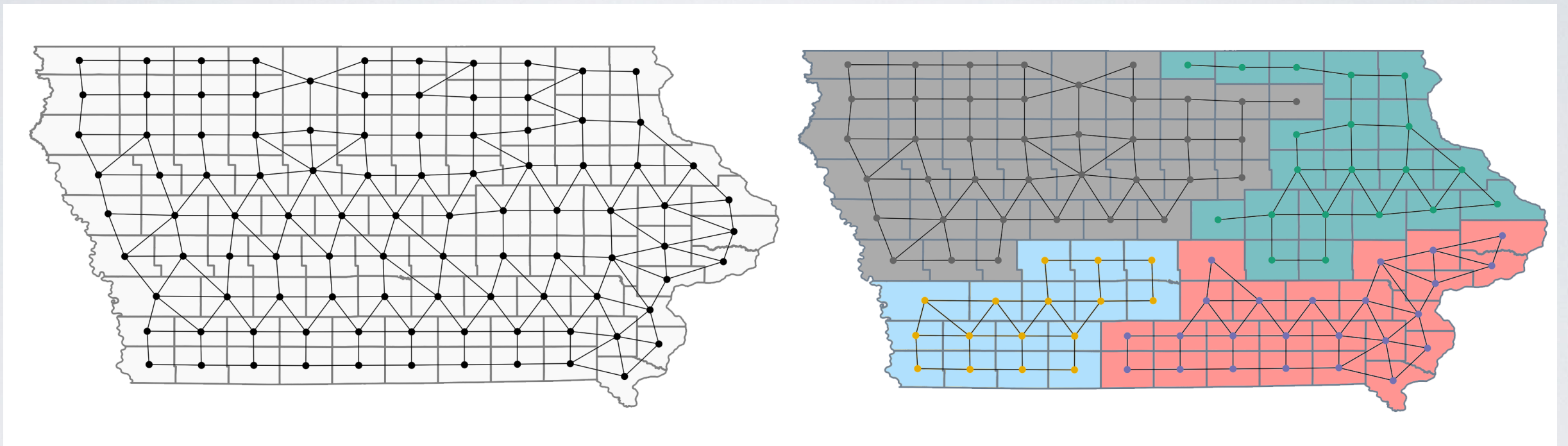
tinyurl.com/normative-blog

EXTRAS

- 1. Enumerating the plans**
- 2. Sampling the plans**
- 3. The data challenge**

HOW MANY MAPS?

DISTRICTS AS GRAPH PARTITIONS



Iowa's 99 counties

Form dual graph, partition into four connected
subgraphs of \sim equal population

WHY SO HARD?

Warmup: 4x4 grid

WHY SO HARD?

Warmup: 4x4 grid



WHY SO HARD?

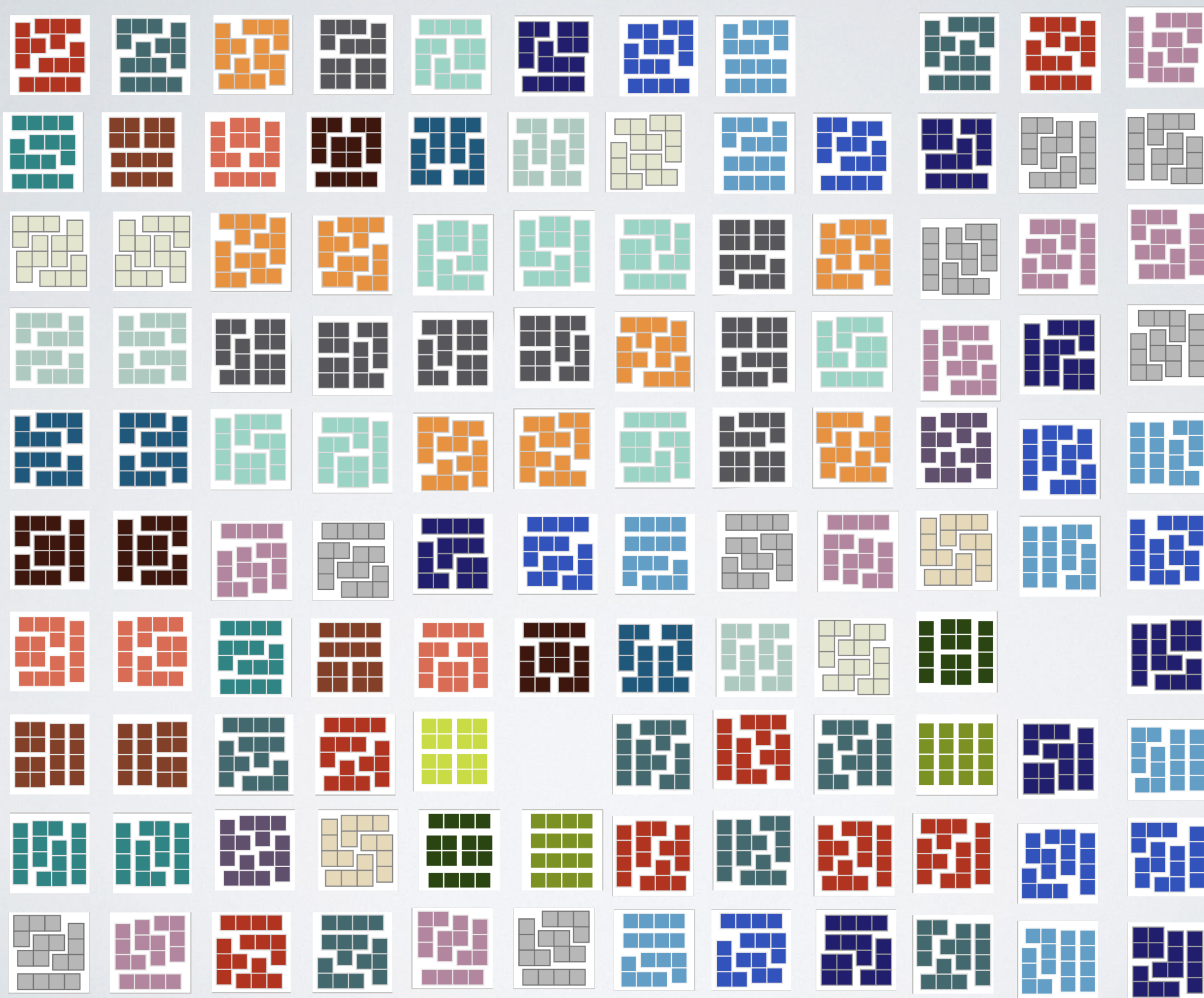
Warmup: 4x4 grid



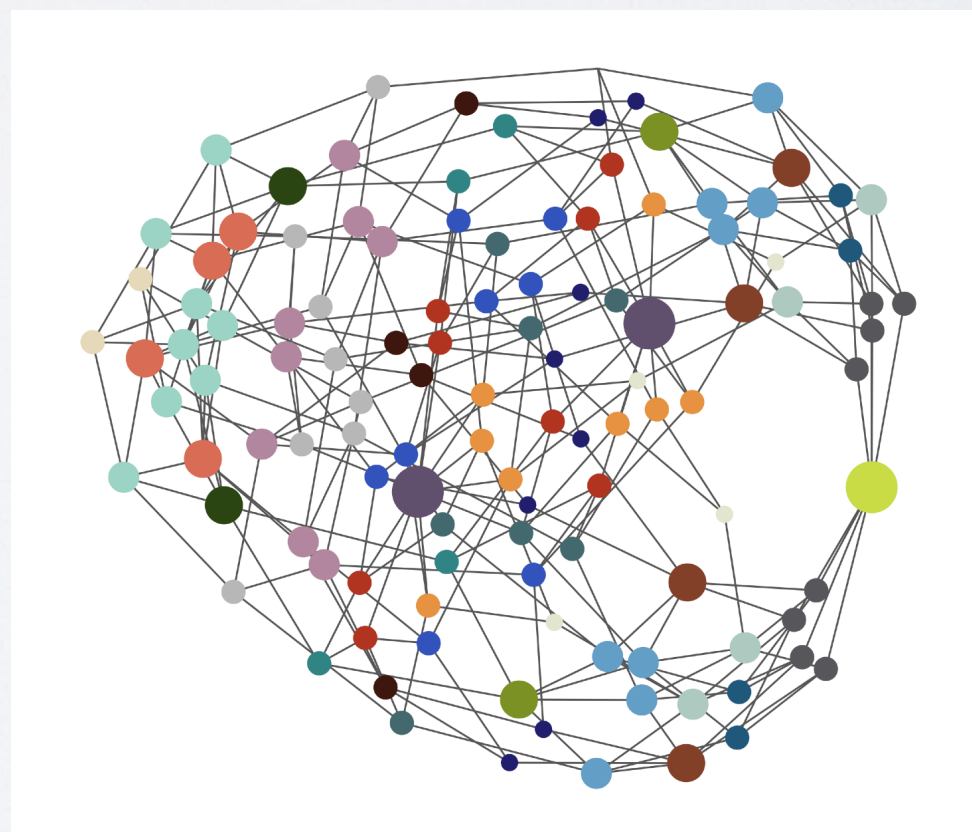
WHY SO HARD?

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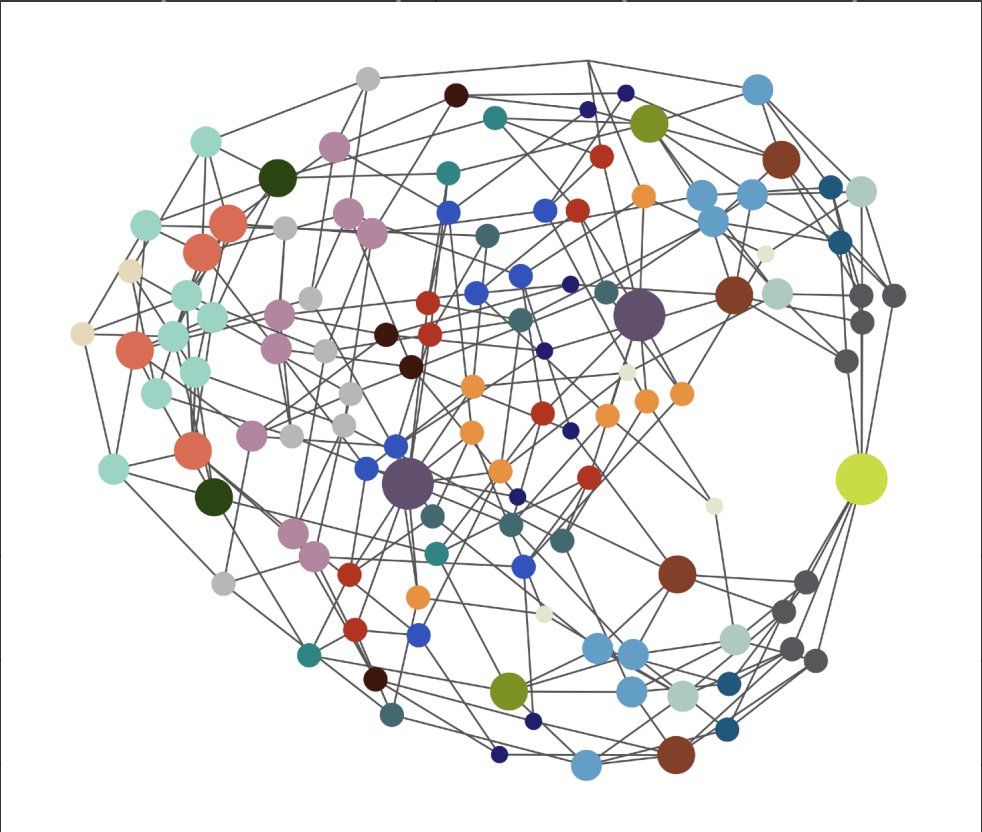




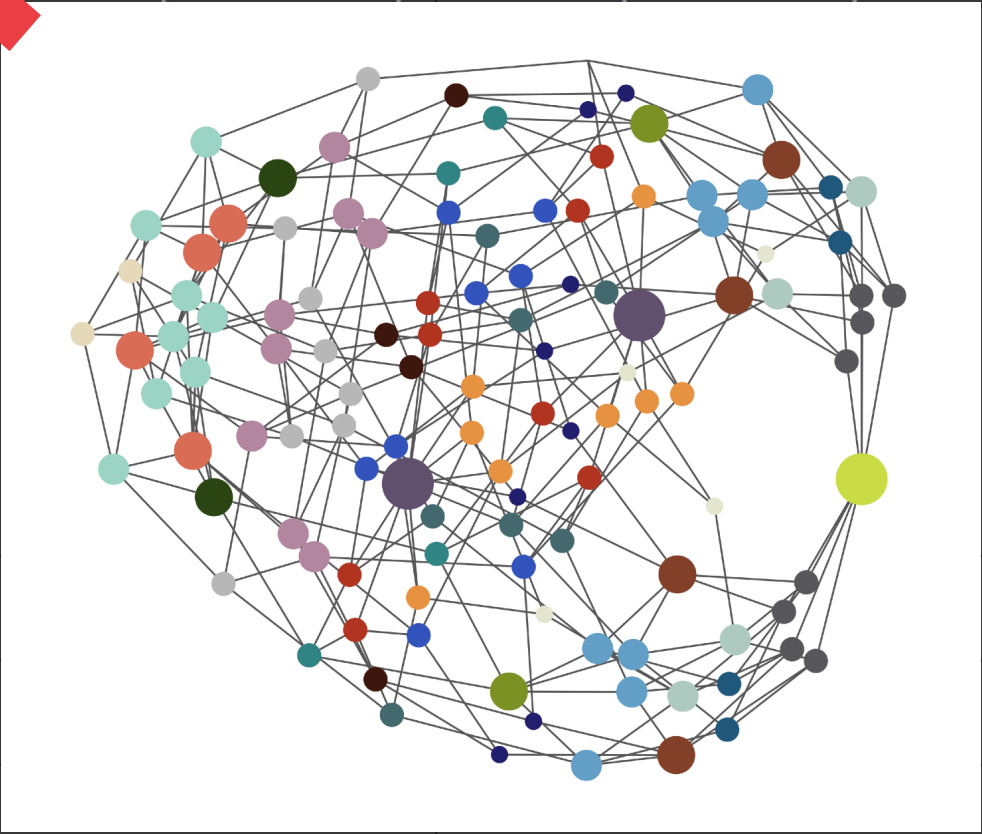
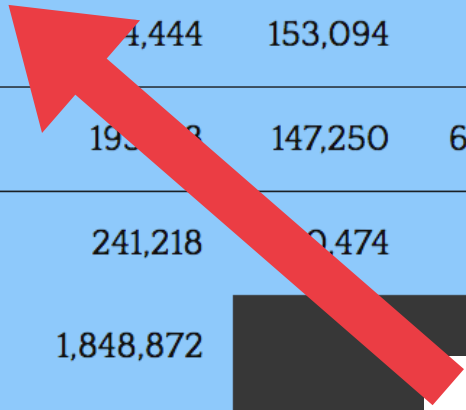




	Rook					Queen				
	equal size	± 1	± 2	± 3	all, non-∅	equal size	± 1	± 2	± 3	all, non-∅
2x2 → 2	2	6	6	6	6	3	7	7	7	7
3x3 → 3	10	58	170	226	258	36	224	622	746	782
4x4 → 2	70	206	338	454	627	1,718	4,690	6,630	7,598	8,171
4x4 → 4	117	1,953	8,849	29,069	62,741	2,620	46,456	222,398	710,622	1,130,612
4x4 → 8	36	34,444	153,094	251,230	340,198	280	567,725	2,629,081	4,262,917	5,362,109
5x5 → 5	4,006	193,128	147,250	6,194,822	?	1,397,790	70,491,206	?	?	?
6x6 → 2	80,518	241,218	400,474	557,031	1,123,743	?	?	?	?	?
6x6 → 3	264,500	1,848,872	?	?	?	?	?	?	?	?
6x6 → 4	442,791	8,313,719	?					?	?	?
6x6 → 6	451,206	61,412,106	?					?	?	?
6x6 → 9	178,939	600,896,399	?					?	?	?
6x6 → 12	80,092	?	?					?	?	?
6x6 → 18	6,728	?	?					?	?	?
7x7 → 7	158,753,814	?	?					?	?	?
8x8 → 8	187,497,290,034	?	?					?	?	?
9x9 → 9	706,152,947,468,301	?	?					?	?	?



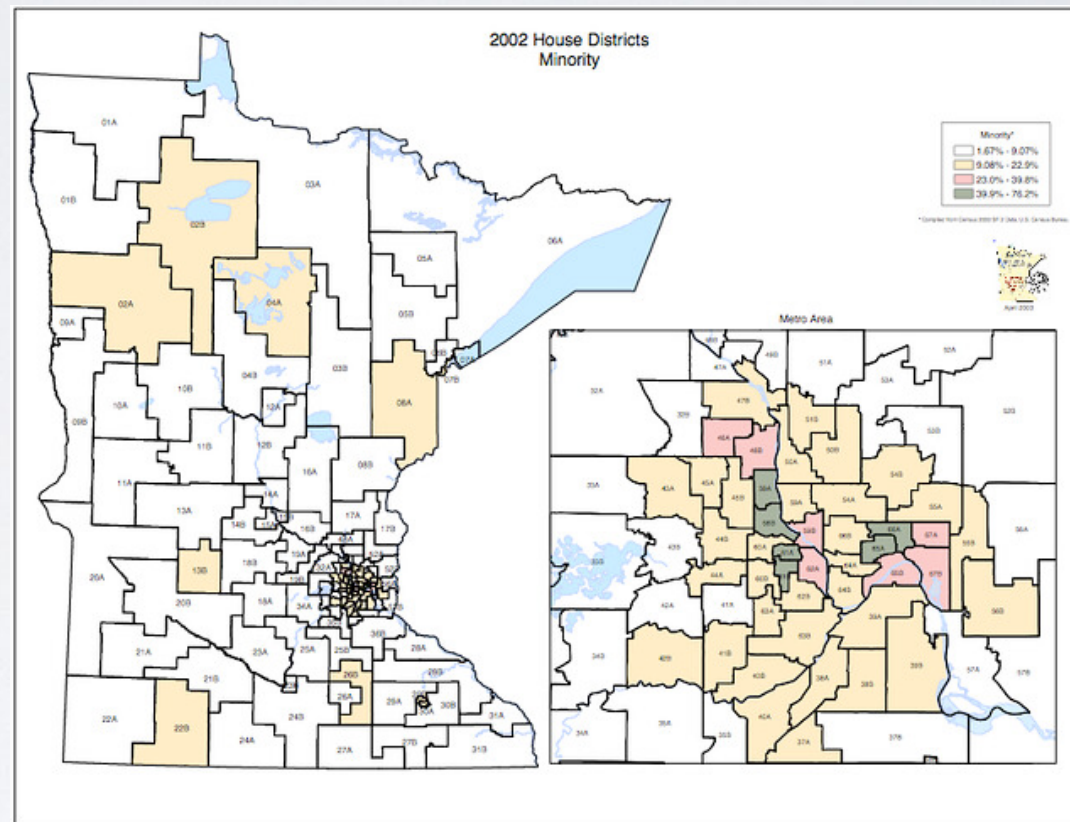
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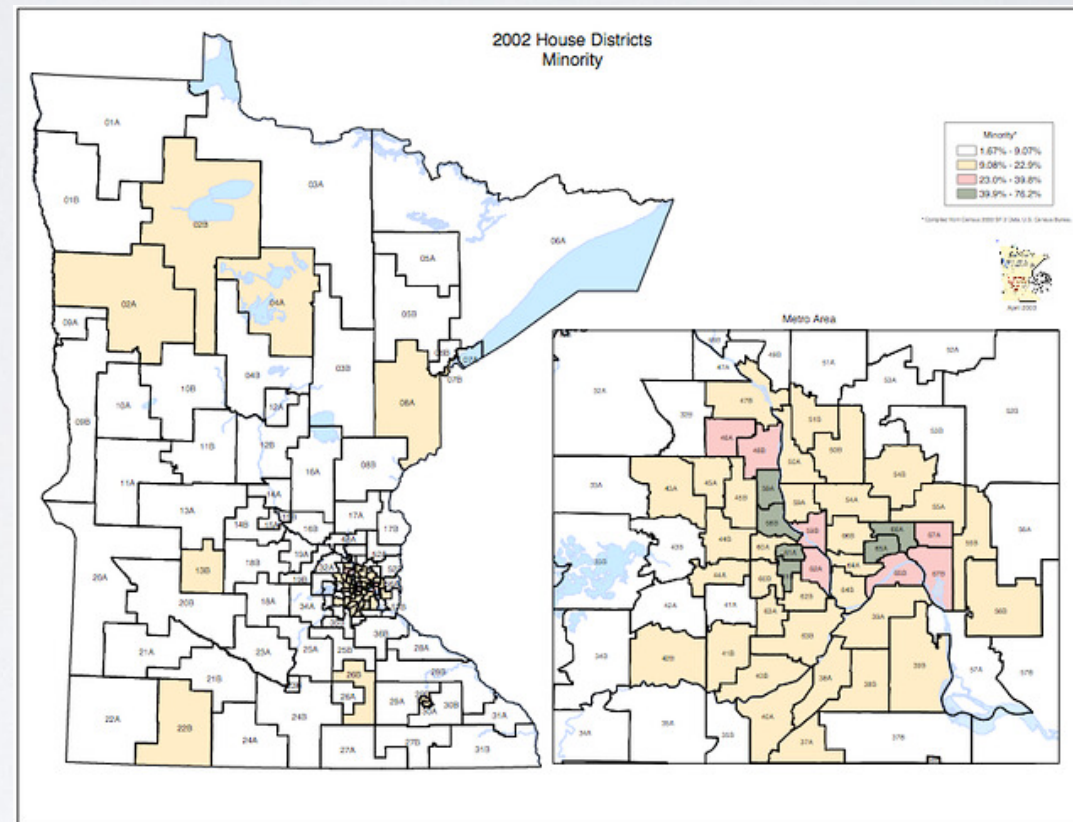
How many ways to make 67 state Senate districts in Minnesota?



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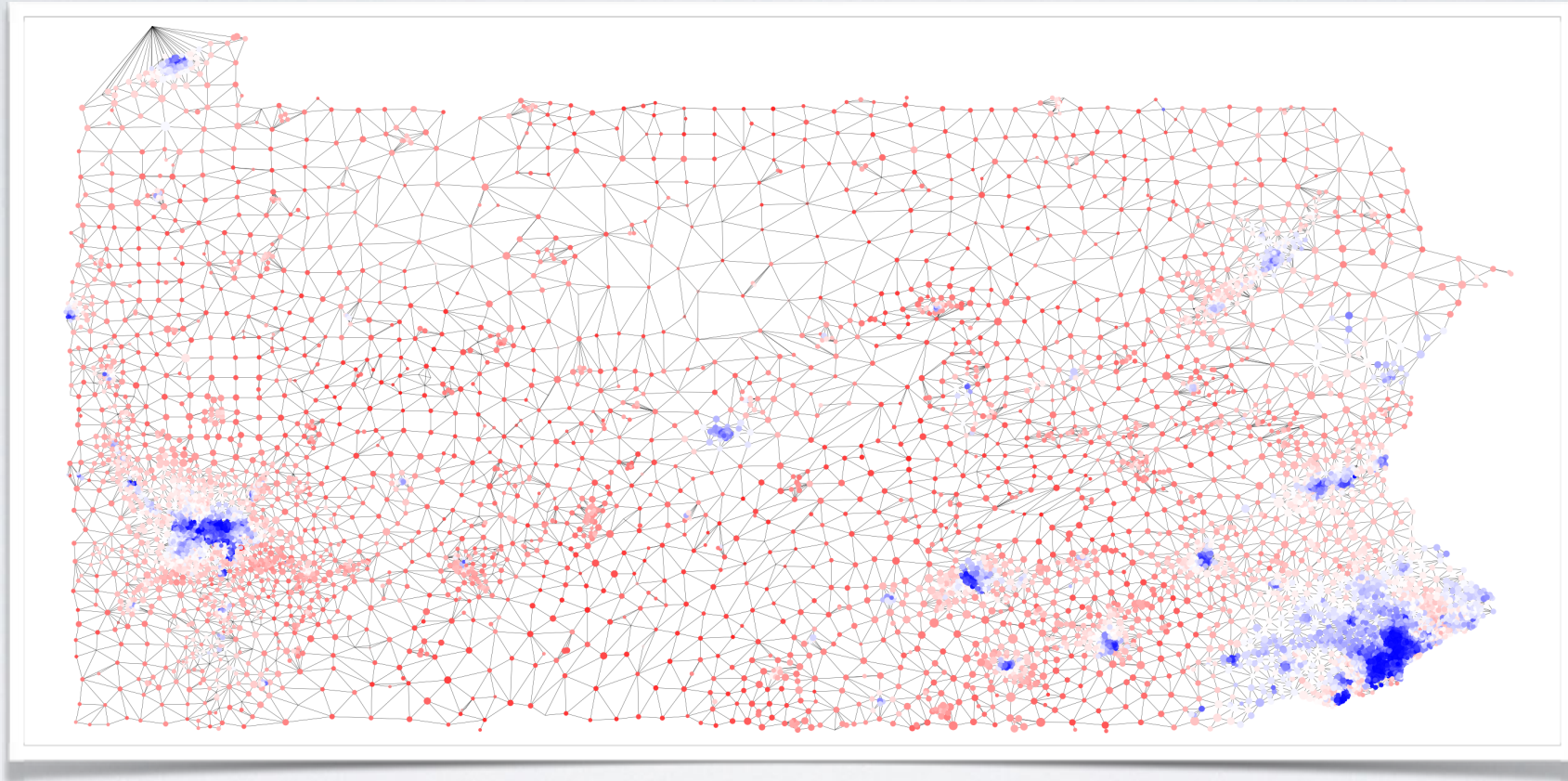


How many ways to make 67 state Senate districts in Minnesota?



just from pairing:
6,156,723,718,225,577,984

HOW BIG OF A PROBLEM?

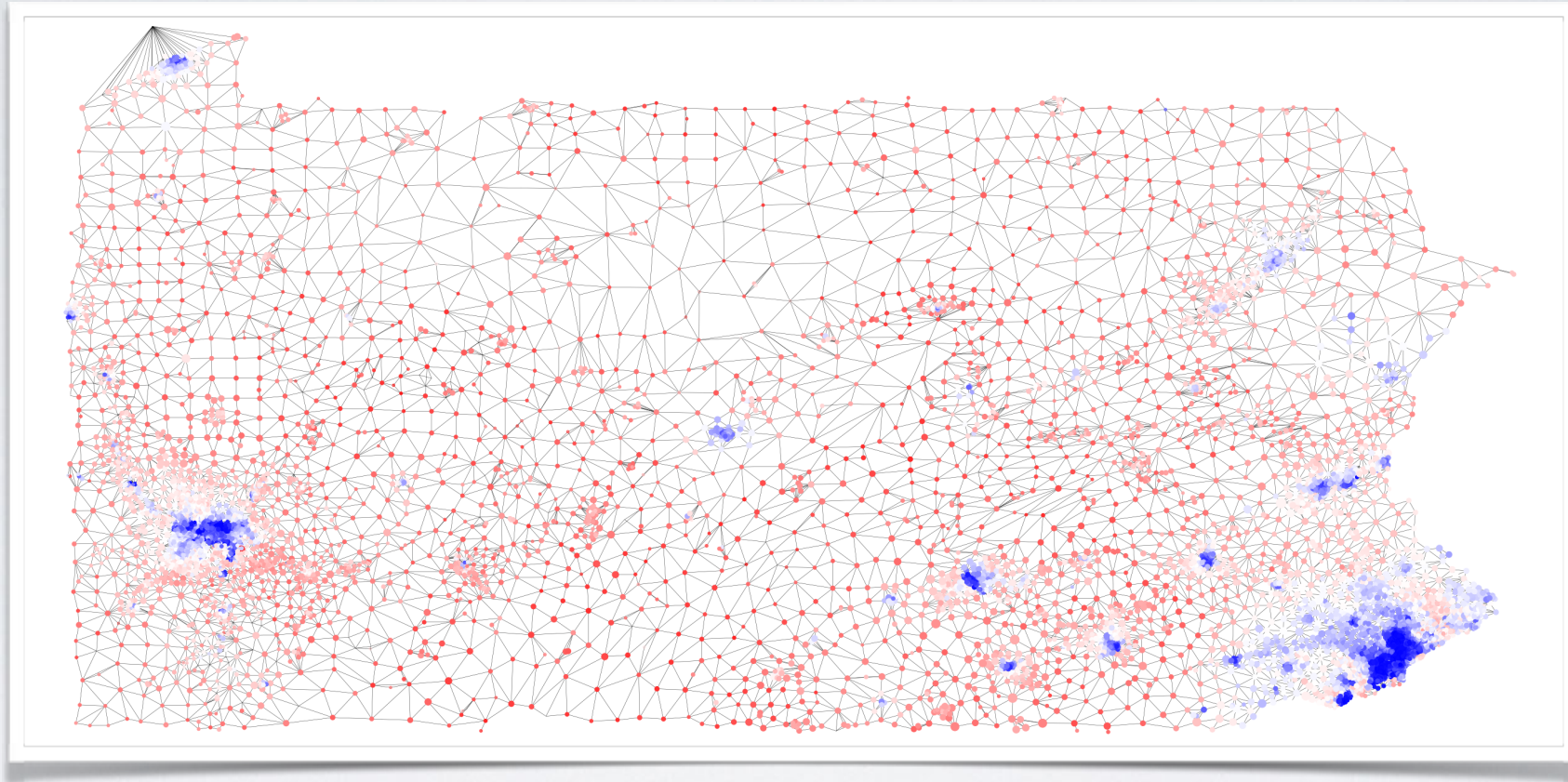


e.g., Pennsylvania has 9059 precincts

421,545 census blocks

18 Congressional districts, 50 state Senate, 160 state House

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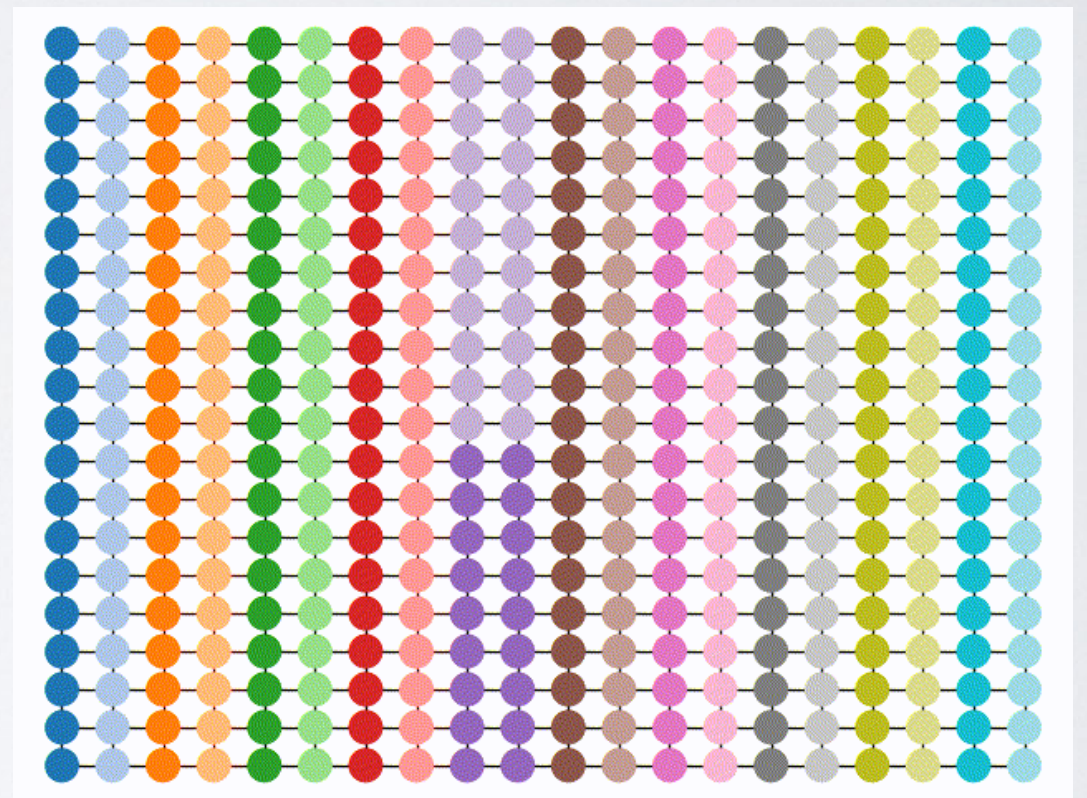
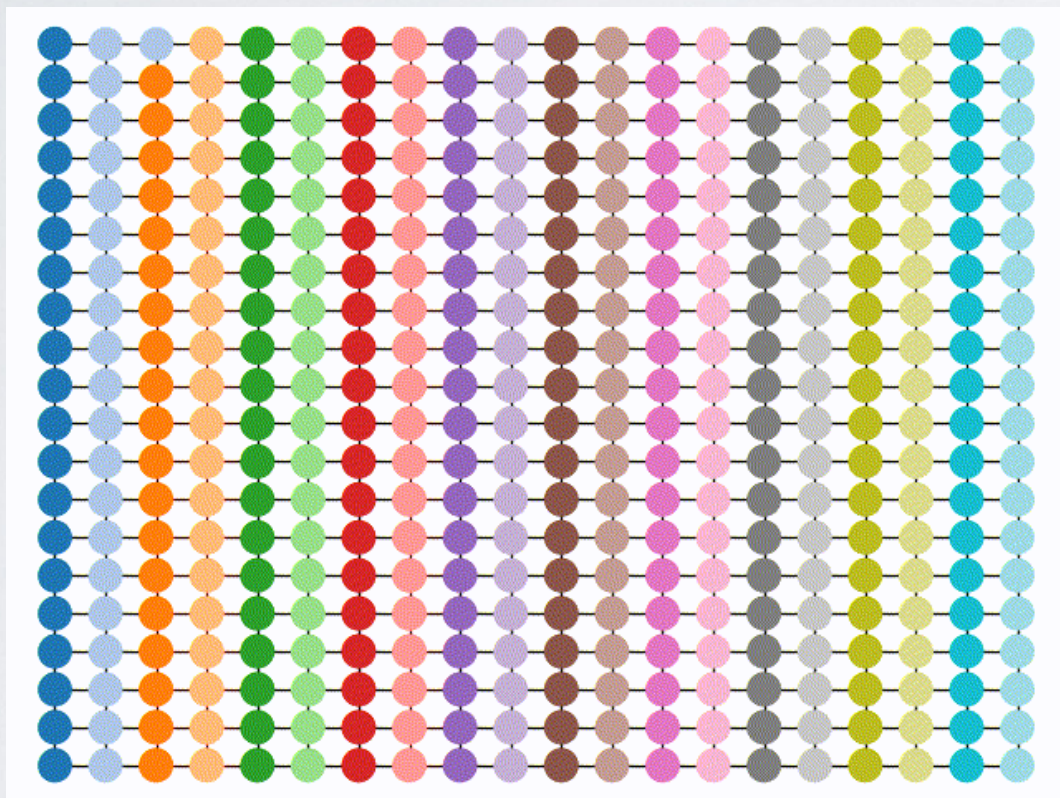
18 Congressional districts, 50 state Senate, 160 state House

10,000,000,000,000,000,000,000,000,000,000,000,000,000,
000,000,000,000,000,000,000,000,000,000,000,000,00
0,000,000,000,000,000,000,000,000,000,000,000 (ish)

THE SCIENCE OF SAMPLING

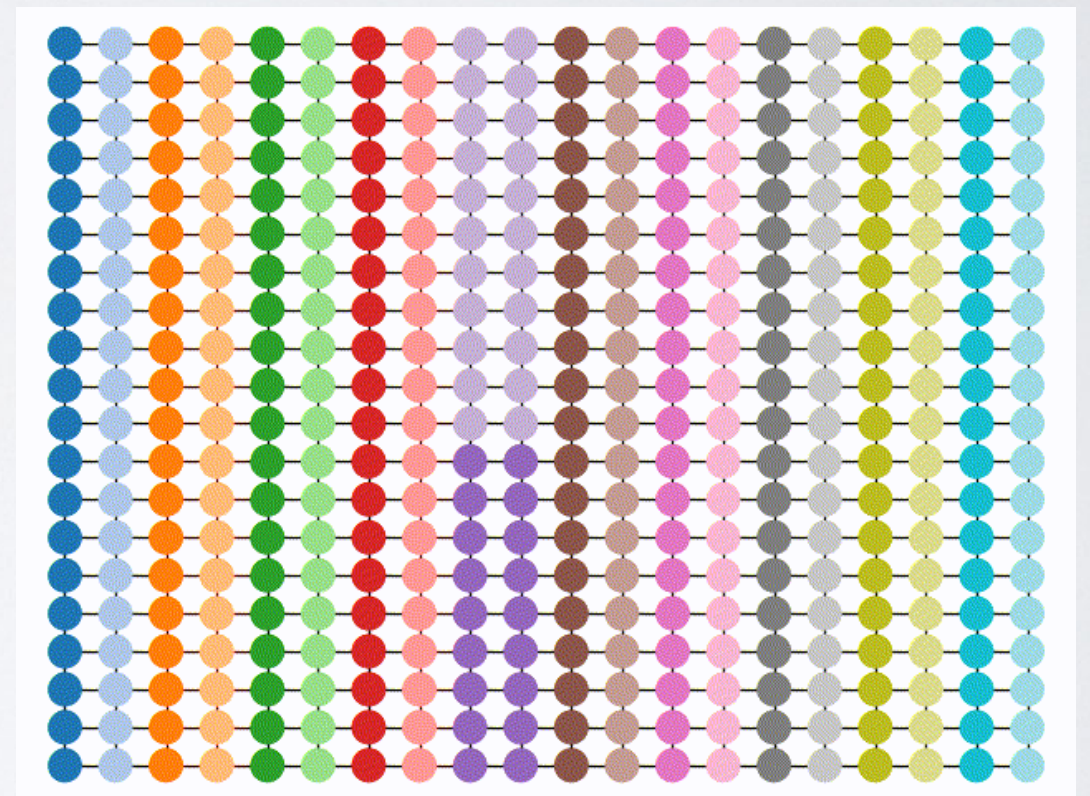
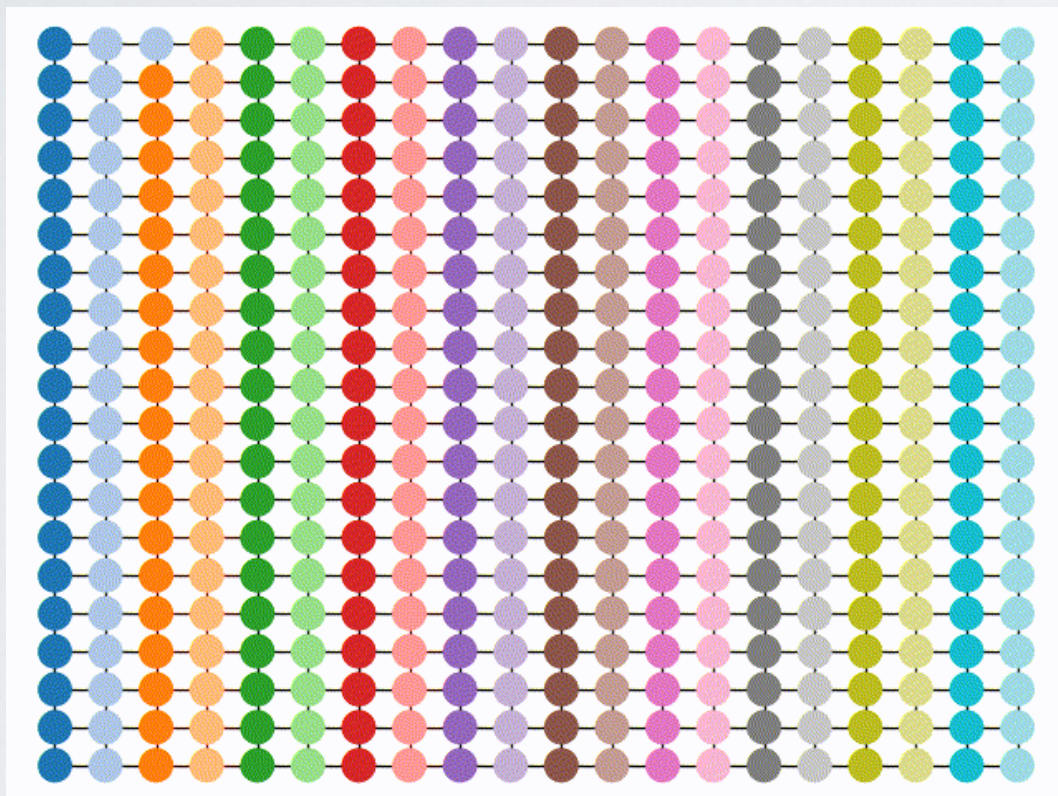
FINDING THE BASELINE

Randomized algorithms let us explore the vast universe of possible districting plans



FINDING THE BASELINE

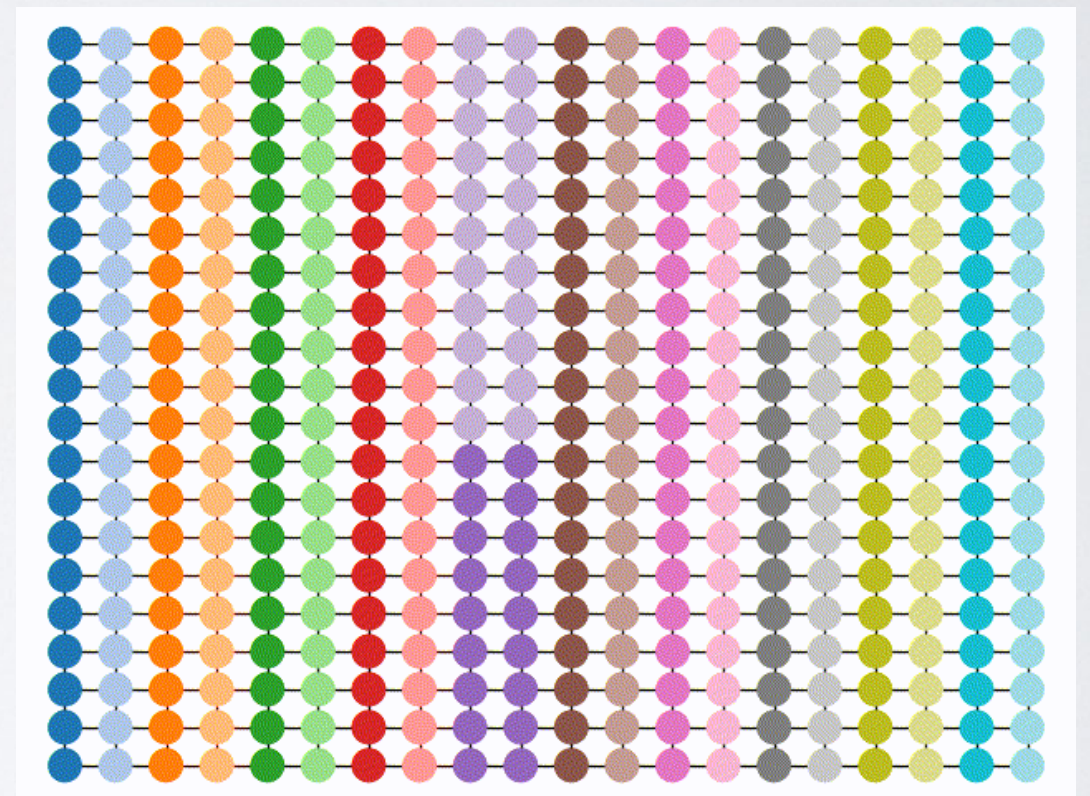
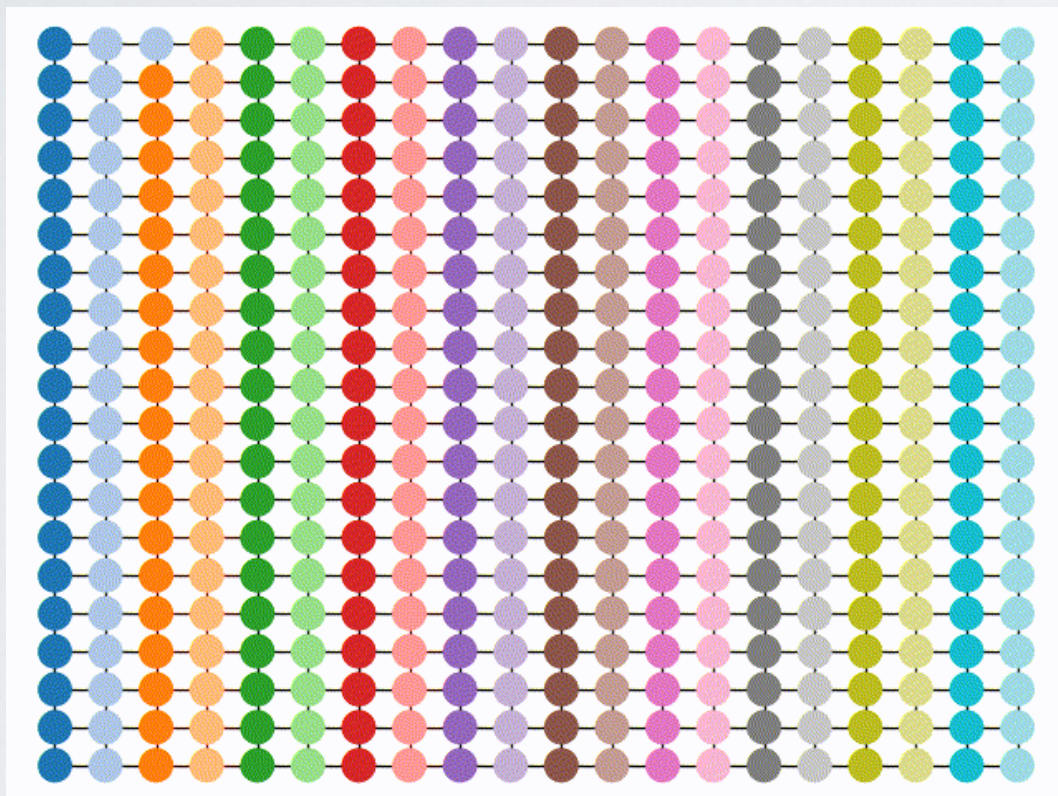
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Two Markov chain Monte Carlo algorithms:
Flip and **Recombination**

FINDING THE BASELINE

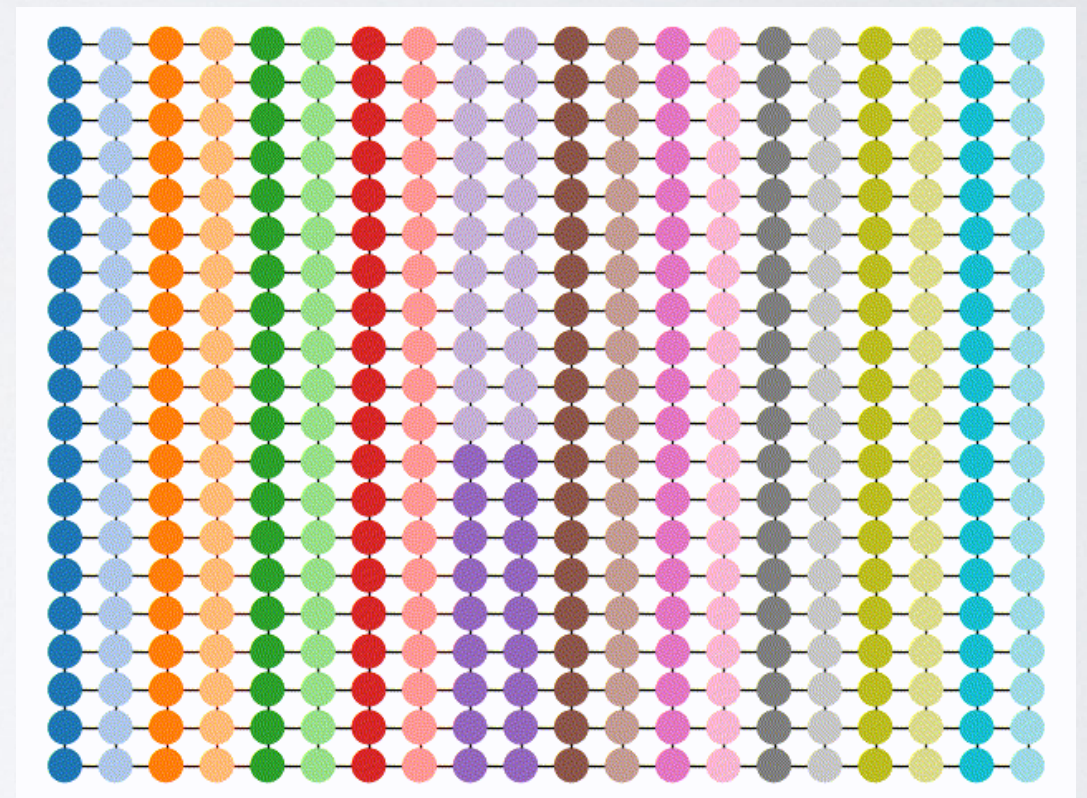
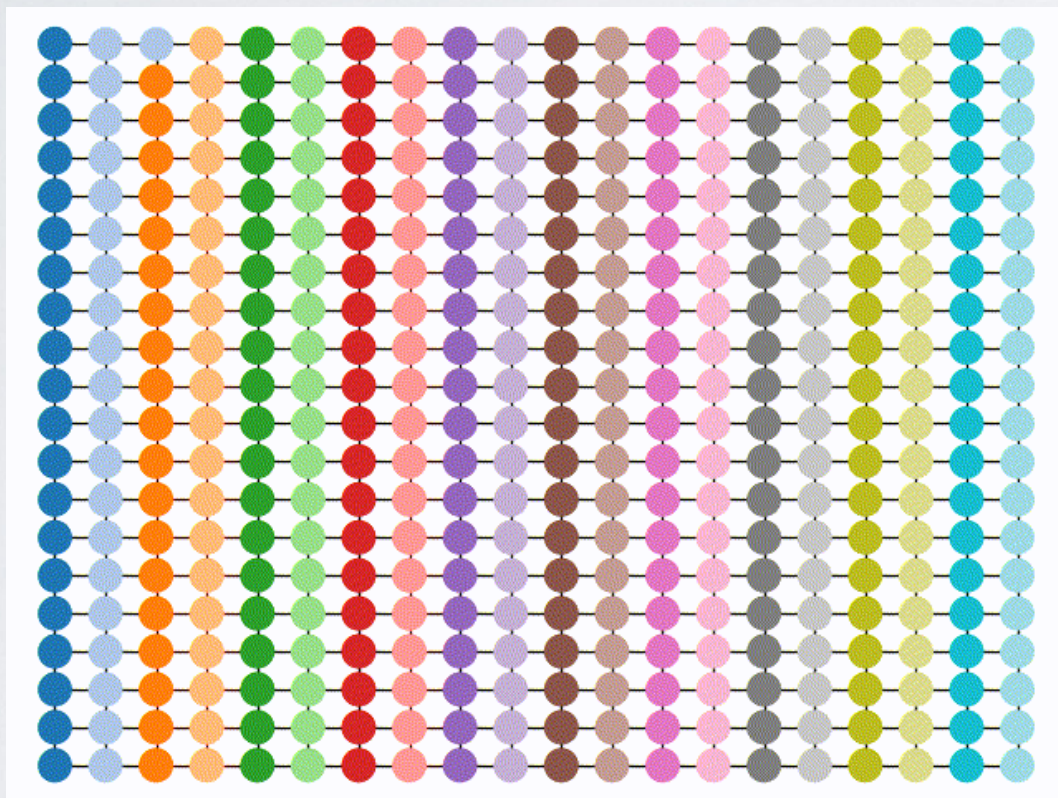
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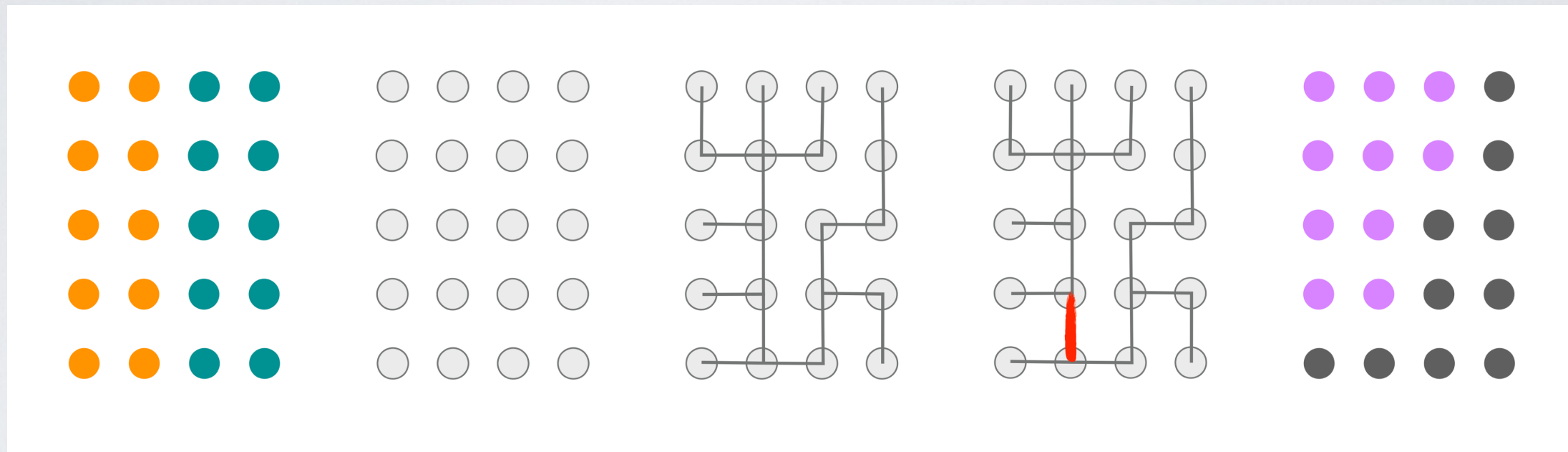
FINDING THE BASELINE

Randomized algorithms let us explore the vast universe of possible districting plans



Two Markov chain Monte Carlo algorithms:
Flip and **Recombination**

SPANNING TREE RECOMBINATION



Merge; choose uniformly from spanning trees; seek balanced cut

FLIP vs RECOM

- Flip has some **pros**: reversible, can be uniformized, can be Metropolized. In principle, you can write down the stationary distribution.
- Flip has some **cons**: insanely slow-mixing, supported on fractals. Requires piles and piles of user choices.

FLIP vs RECOM

FLIP vs RECOM

- Pegden estimates “dozens of trillions” of Flip steps are needed between each map on a 80x80 grid (which is still smaller than Pennsylvania’s precinct dual graph)

FLIP vs RECOM

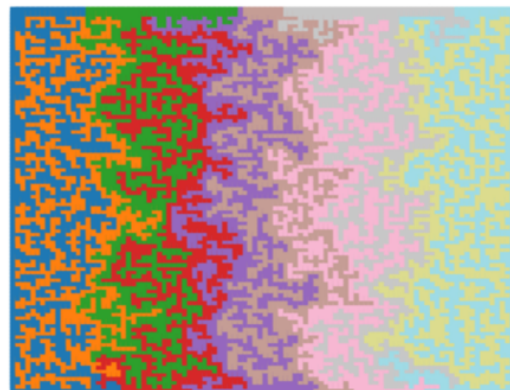
- Pegden estimates “dozens of trillions” of Flip steps are needed between each map on a 80x80 grid (which is still smaller than Pennsylvania’s precinct dual graph)
- Same independence achieved with < 100 ReCom steps

FLIP vs RECOM

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(a) Initial Partition



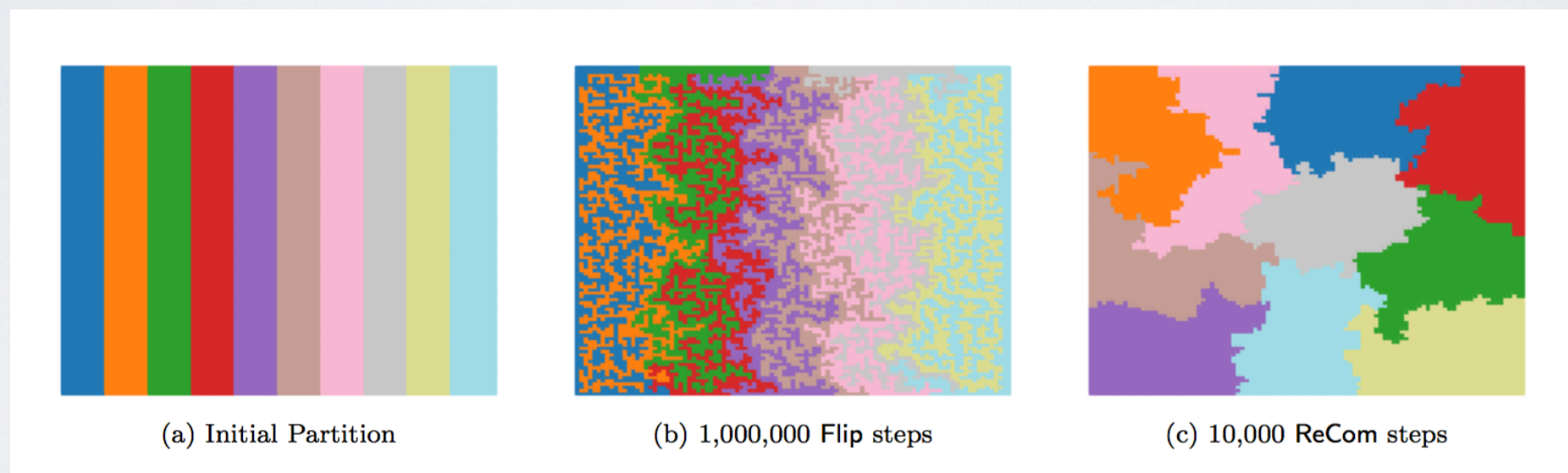
(b) 1,000,000 Flip steps



(c) 10,000 ReCom steps

FLIP vs RECOM

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- Same independence achieved with < 100 ReCom steps



- Once they do mix, do they get the same answers to redistricting questions? (i.e., do they draw from the same distribution?) ...
Subtle, hard issue.

COMPUTATIONAL COMPLEXITY

- DeFord-Najt-Solomon: for any $0 < x \leq 1$, efficient sampling proportional to $x^{| \partial P |}$ implies $RP = NP$.

MANY GOOD
OPEN QUESTIONS

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- “Isospanimetric conjecture”

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MANY GOOD OPEN QUESTIONS

- “Isospanimetric conjecture”
- Balanced cuts of trees
- Ergodicity, stationary distribution for spanning tree ReCom, diameter bounds for metagraph, curvature of state space
- Rapid mixing for ReCom on $n \times n$ grids, k districts, $n \rightarrow \infty$
- Other recombination moves

THE DATA ITSELF

BUILDING THE DATASET

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At VRDI 2018, we called all 88 counties in Ohio to ask the simple question, where are your precincts?

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8 counties sent paper maps 🖐️

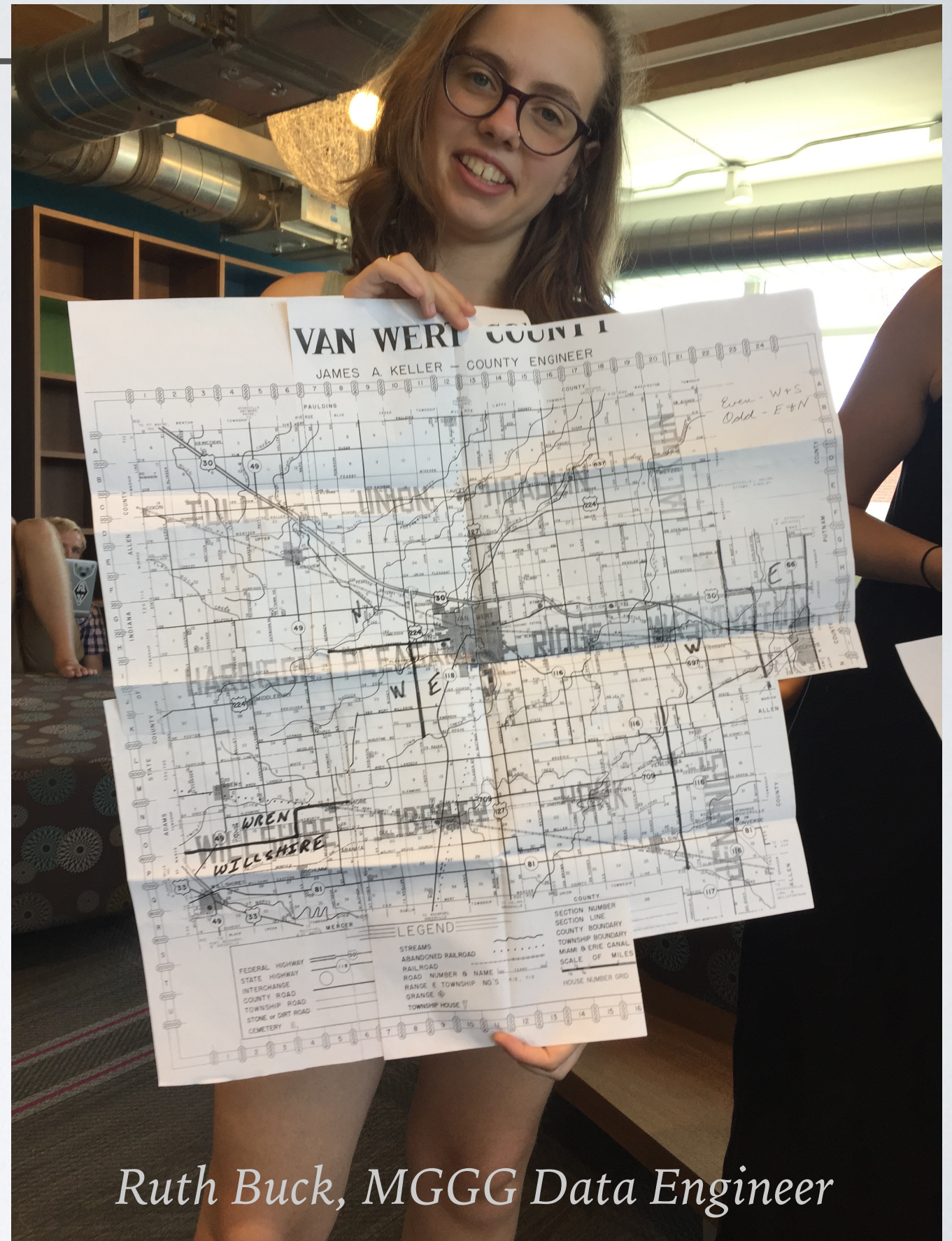
BUILDING T

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Ruth Buck, MGGG Data Engineer

BUILDING T

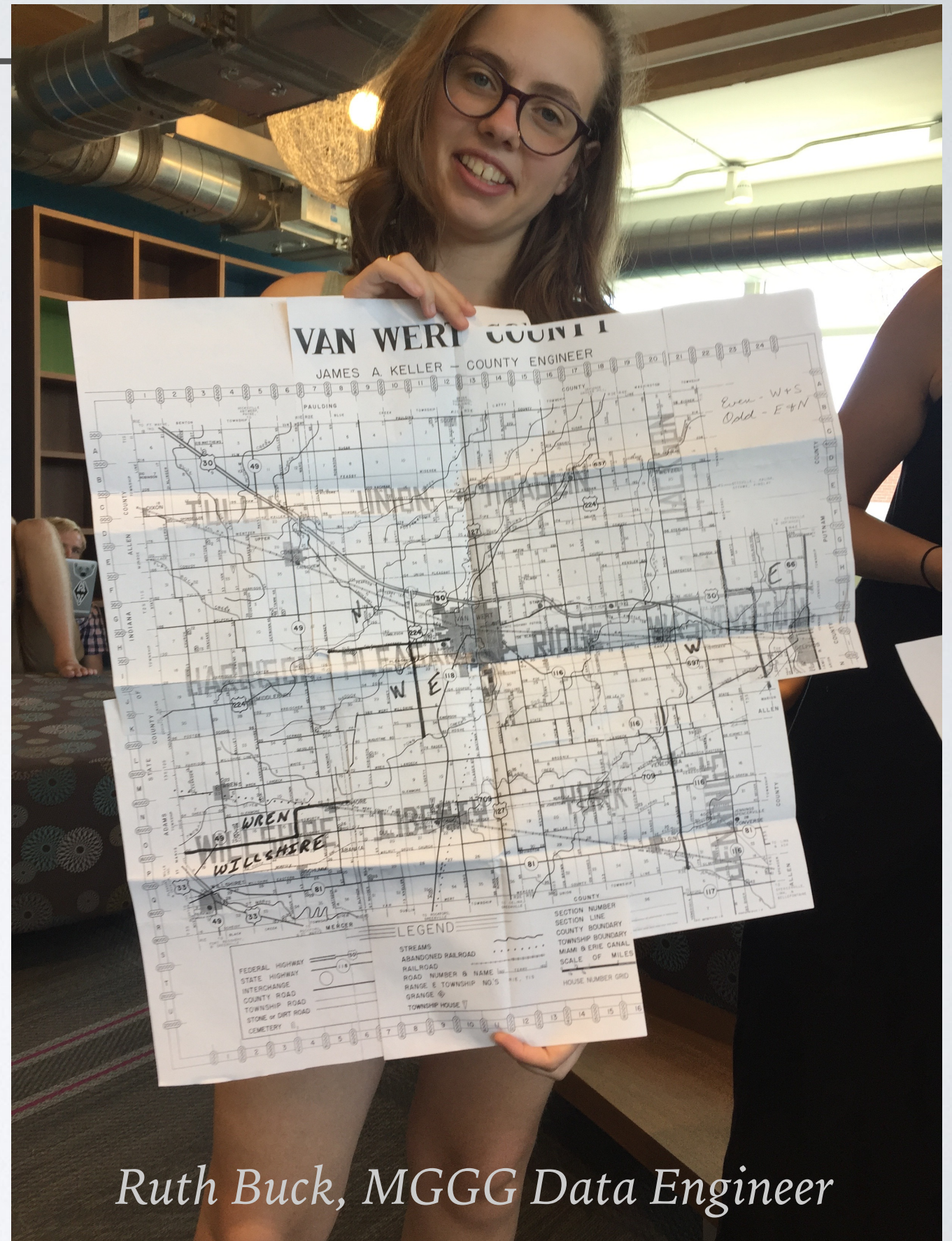
At VRDI 2018, we called all 88 counties in Ohio to ask the simple question, where are your precincts?

46 counties had shapefiles

27 counties had PDF maps

8 counties sent paper maps 🖱️

7 had nothing



Ruth Buck, MGGG Data Engineer

We've built a user-friendly data interface

districtr.org

